Nokia Customer Care

Service Manual

RA-6 (Nokia E90 Communicator; L3&4)
Mobile Terminal
Part No: 9254834 (Issue 1)

COMPANY CONFIDENTIAL

Amendment Record Sheet

Amendment No	Date	Inserted By	Comments
Issue 1	05/2007	TSa	

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IMPORTANT

This document is intended for use by qualified service personnel only.

Warnings and cautions

Warnings

- IF THE DEVICE CAN BE INSTALLED IN A VEHICLE, CARE MUST BE TAKEN ON INSTALLATION IN VEHICLES FITTED WITH ELECTRONIC ENGINE MANAGEMENT SYSTEMS AND ANTI-SKID BRAKING SYSTEMS. UNDER CERTAIN FAULT CONDITIONS, EMITTED RF ENERGY CAN AFFECT THEIR OPERATION. IF NECESSARY, CONSULT THE VEHICLE DEALER/ MANUFACTURER TO DETERMINE THE IMMUNITY OF VEHICLE ELECTRONIC SYSTEMS TO RF ENERGY.
- THE PRODUCT MUST NOT BE OPERATED IN AREAS LIKELY TO CONTAIN POTENTIALLY EXPLOSIVE ATMOSPHERES, FOR EXAMPLE, PETROL STATIONS (SERVICE STATIONS), BLASTING AREAS ETC.
- OPERATION OF ANY RADIO TRANSMITTING EQUIPMENT, INCLUDING CELLULAR TELEPHONES, MAY INTERFERE WITH THE FUNCTIONALITY OF INADEQUATELY PROTECTED MEDICAL DEVICES. CONSULT A PHYSICIAN OR THE MANUFACTURER OF THE MEDICAL DEVICE IF YOU HAVE ANY QUESTIONS. OTHER ELECTRONIC EQUIPMENT MAY ALSO BE SUBJECT TO INTERFERENCE.
- BEFORE MAKING ANY TEST CONNECTIONS, MAKE SURE YOU HAVE SWITCHED OFF ALL EQUIPMENT.

Cautions

- Servicing and alignment must be undertaken by qualified personnel only.
- Ensure all work is carried out at an anti-static workstation and that an anti-static wrist strap is worn.
- Ensure solder, wire, or foreign matter does not enter the telephone as damage may result.
- Use only approved components as specified in the parts list.
- Ensure all components, modules, screws and insulators are correctly re-fitted after servicing and alignment.
- Ensure all cables and wires are repositioned correctly.
- Never test a mobile phone WCDMA transmitter with full Tx power, if there is no possibility to perform the measurements in a good performance RF-shielded room. Even low power WCDMA transmitters may disturb nearby WCDMA networks and cause problems to 3G cellular phone communication in a wide area.
- During testing never activate the GSM or WCDMA transmitter without a proper antenna load, otherwise GSM or WCDMA PA may be damaged.

ESD protection

Nokia requires that service points have sufficient ESD protection (against static electricity) when servicing the phone.

Any product of which the covers are removed must be handled with ESD protection. The SIM card can be replaced without ESD protection if the product is otherwise ready for use.

To replace the covers ESD protection must be applied.

All electronic parts of the product are susceptible to ESD. Resistors, too, can be damaged by static electricity discharge.

All ESD sensitive parts must be packed in metallized protective bags during shipping and handling outside any ESD Protected Area (EPA).

Every repair action involving opening the product or handling the product components must be done under ESD protection.

ESD protected spare part packages MUST NOT be opened/closed out of an ESD Protected Area.

For more information and local requirements about ESD protection and ESD Protected Area, contact your local Nokia After Market Services representative.

Care and maintenance

This product is of superior design and craftsmanship and should be treated with care. The suggestions below will help you to fulfil any warranty obligations and to enjoy this product for many years.

- Keep the phone and all its parts and accessories out of the reach of small children.
- Keep the phone dry. Precipitation, humidity and all types of liquids or moisture can contain minerals that will corrode electronic circuits.
- Do not use or store the phone in dusty, dirty areas. Its moving parts can be damaged.
- Do not store the phone in hot areas. High temperatures can shorten the life of electronic devices, damage batteries, and warp or melt certain plastics.
- Do not store the phone in cold areas. When it warms up (to its normal temperature), moisture can form inside, which may damage electronic circuit boards.
- Do not drop, knock or shake the phone. Rough handling can break internal circuit boards.
- Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the phone.
- Do not paint the phone. Paint can clog the moving parts and prevent proper operation.
- Use only the supplied or an approved replacement antenna. Unauthorised antennas, modifications or attachments could damage the phone and may violate regulations governing radio devices.

All of the above suggestions apply equally to the product, battery, charger or any accessory.

Company Policy

Our policy is of continuous development; details of all technical modifications will be included with service bulletins.

While every endeavour has been made to ensure the accuracy of this document, some errors may exist. If any errors are found by the reader, NOKIA MOBILE PHONES Business Group should be notified in writing/e-mail.

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- Title of the Document + Issue Number/Date of publication
- Latest Amendment Number (if applicable)
- Page(s) and/or Figure(s) in error

Please send to:

NOKIA CORPORATION
Nokia Mobile Phones Business Group
Nokia Customer Care
PO Box 86
FIN-24101 SALO
Finland
E-mail: Service.Manuals@nokia.com

Battery information

Note: A new battery's full performance is achieved only after two or three complete charge and discharge cycles!

The battery can be charged and discharged hundreds of times but it will eventually wear out. When the operating time (talk-time and standby time) is noticeably shorter than normal, it is time to buy a new battery.

Use only batteries approved by the phone manufacturer and recharge the battery only with the chargers approved by the manufacturer. Unplug the charger when not in use. Do not leave the battery connected to a charger for longer than a week, since overcharging may shorten its lifetime. If left unused a fully charged battery will discharge itself over time.

Temperature extremes can affect the ability of your battery to charge.

For good operation times with Ni-Cd/NiMh batteries, discharge the battery from time to time by leaving the product switched on until it turns itself off (or by using the battery discharge facility of any approved accessory available for the product). Do not attempt to discharge the battery by any other means.

Use the battery only for its intended purpose.

Never use any charger or battery which is damaged.

Do not short-circuit the battery. Accidental short-circuiting can occur when a metallic object (coin, clip or pen) causes direct connection of the + and - terminals of the battery (metal strips on the battery) for example when you carry a spare battery in your pocket or purse. Short-circuiting the terminals may damage the battery or the connecting object.

Leaving the battery in hot or cold places, such as in a closed car in summer or winter conditions, will reduce the capacity and lifetime of the battery. Always try to keep the battery between 15°C and 25°C (59°F and 77°F). A phone with a hot or cold battery may temporarily not work, even when the battery is fully charged. Batteries' performance is particularly limited in temperatures well below freezing.

Do not dispose of batteries in a fire!

Dispose of batteries according to local regulations (e.g. recycling). Do not dispose as household waste.

Nokia E90 Communicator; L3&4 Service Manual Structure

1 General Information
2 Service Tools and Service Concepts
3 BB Troubleshooting and Tuning Guide
4 RF troubleshooting
5 Camera Module Troubleshooting
6 System Module
Glossary

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1 — General Information

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RA-6 product selection

RA-6 is a WCDMA/GSM dual mode handportable phone supporting EGSM850/900/1800/1900 and WCDMA2100.

RA-6 is a 3GPP Release 5 terminal supporting WCDMA/HSDPA, EGPRS and GPRS data bearers. For WCDMA HSDPA the maximum bit rate is up to 3.6 Mbps for downlink and 384 kbps for uplink with simultaneous CS speech or CS video (max. 64 kbps).

For 2G and 2.5G networks the RA-6 is a Class A EGPRS DTM MSC 11 which means maximum download speed of up to 236.8 kbps simultaneously with speech or Class B EGPRS MSC 32 which means a in maximum download speed of up to 296kbit/s with EGPRS, and up to 107kbit/s with GPRS.

According to GSM standard 05.05 it responds to class 4 (max. 2W) in GSM 850 and EGSM 900 class 1 (1W) in DCS 1800 and class 1 in PCS 1900. RA-6 supports EGPRS (EDGE) class B as well as Bluetooth 2.0 EDR standard.

RA-6 supports two way video calls with two integrated cameras, one on the front and one on the back.

RA-6 is an MMS (Multimedia Messaging Service) enabled multimedia computer with a large 2.6'' QVGA (240 x 320 pixels) TFT colour display and an integrated 5 Megapixel auto focus camera. The MMS implementation follows the OMA MMS standard release 1.2. The Browser is a highly advanced internet browser also capable of viewing operator domain XHTML Mobile Profile (MP) content.

RA-6 uses Symbian 9.2 operating system and supports also MIDP Java 2.0 & CLDC1.1, providing a good platform for compelling 3rd party applications.

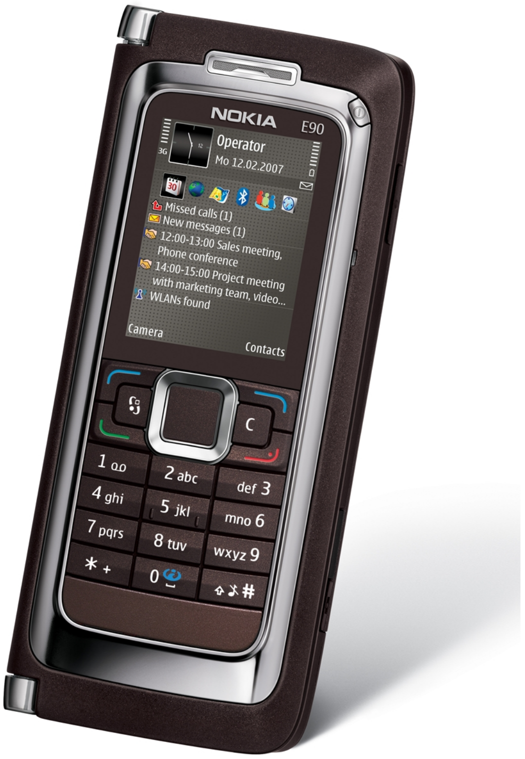
NOKIA
E90
Operator
Mo 12.02.2007
Missed calls (1)
New messages (1)
12:00-13:00 Sales meeting, Phone conference
14:00-15:00 Project meeting with marketing team, video...
WLANs found
Camera
Contacts

Figure 1 View of RA-6

RA-6 product features and sales package

Communicator display and keypad

- Active matrix colour display (800 x 352), 16M colours
- 5-way rocker key, 2 soft keys beside screen, send and end keys
- Full keyboard with backlight (separate key to activate light), Application shortcut keys, Series60 application key, profile key

- Shortcuts to (chr+): Bluetooth, IR, help, volume control (call volume)

Cover display and ITU-T keypad

- Active matrix colour display (240 x 320), 16M colours •
- Full telephone keypad: Send and End keys, two separate Soft Keys, 5 way rocker, Power (including profile), Application key, C key, Nib on the “5” key number keys. The Zero key has the wireless internet symbol (long press activates web), silent profile activation in hash key

Hardware characteristics

- Communicator clamshell concept
- At least 128 MB free memory for user data and applications
- microSD (hot swap) memory card
- Integrated hands free speaker
- Internal Vibra
- Integrated GPS
- Integrated camera(s), 3Mpix with flash and autofocus, second camera QCIF for video calling

Connectivity

- Quad band GSM (850/900/1800/1900), WCDMA 2100
- GPRS/EGPRS (Class A, MSC 32)
- Dual mode transfer MSC11, SAIC rel v1
- HSDPA 3.6Mbit/s
- Mini USB type B interface with USB 2.0 full speed
- 3.5mm stereo headphone plug and TV out support (PAL/NTSC)
- Bluetooth wireless technology 2.0
- Infrared (SIR)
- IrDA
- 3GPP rel 5

Key features

UI and developer platform

- Series 60 Platform 3.1 Edition
- Symbian 9.2
- Java™ MIDP 2.0

Push email & PIM

- Intellisync Wireless Email
- Other emails :BlackBerry Connect, Mail for Exchange, Visto Mobile, Altexia

Native S60 email & PIM

- POP3, IMAP4, SMTP, OMA DS 1.2
- Selectable email account
- Remote contact look-up
- Text-to-speech
- Instant messaging (Yahoo, AOL, OMA 1.2)

- Calendar attachment support
- Meeting requests to calendar
- Calendar plug-in for 3rd party email solutions

Seamless roaming

- Prioritized list of preferred access points •
- 3rd party client (BirdStep) for seamless roaming

Device Managemen

- Intellisync Device management
- OMA Device Management 1.1.2
- OMA Client Provisioning 1.1.2
- OTI firmware update
- Local connectivity with Nokia Suite

Security

- • Secure storage
- Device lock, also remote lock
- OMA DRM 2.0
- Wireless LAN security features
- Memory card lock

Other applications

- Web browser (x)HTML
- QuickOffice office tools
- Gate5 for location based services
- Catalogs application for add on application download
- Nokia Office Tools 2.0
- FM radio

Sales package

- Transceiver RA-6
- Charger (AC-4)
- Battery (BP-4L)
- Stereo headset (HS-47)
- Connectivity cable (DKE-2)
- Video out cable (CA-75U)
- Memory card

Product and module list

Module name	Type code	Notes
System/RF Module		Main PWB with components
UI Module		Keyboard PWB with components. Part of the UI Frame Assy

Module name	Type code	Notes
Front Camera Module		Camera module CIF
Back Camera Module		5MP camera with macro
Display Module		
Engine Shield Assembly		Part of slide assembly
Slide Assembly		Mechanical assembly
Core SW Module		

Mobile enhancements

Table 1 Audio

Enhancement	Type
Headsets	HS-47
	HS-42
Wireless headsets	HS-25W
Inductiove loopset	TBD

Table 2 Car

Enhancement	Type
Mobile Holder and antenna coupler	
Mobile charger	DC-4
Nokia A/V adapter for legacy car kits	HF-6W
Car kit	N616

Table 3 Data

Enhancement	Type
Connectivity adapter cable	DKE-2
MicroSD card	TBD

Table 4 Power

Enhancement	Type
Battery Li-ion	BP-4L
Travel charger	AC-4
	AC-5
Charger adapter	CA-44

Table 5 Carrying

Enhancement	Type
Wrist strap	TBD
Carrying case	

Technical specifications

Transceiver general specifications

Unit	Dimensions (L x W x T) (mm)	Weight (g)	Volume (cm3)
Transceiver with BP-4L Li-ion battery back	132 x 57 x 20 mm	210	140

Main RF characteristics for GSM850/900/1800/1900 and WCDMA1900/2100 phones

Parameter	Unit
Cellular system	GSM850, EGSM900, GSM1800/1900, WCDMA1900 or WCDMA2100
Rx frequency band	GSM850: 869 - 894MHz
	EGSM900: 925 - 960 MHz
	GSM1800: 1805 - 1880 MHz
	GSM1900: 1930 - 1990 MHz
	WCDMA1900: 1930-1990MHz
	WCDMA2100: 2110 - 2170 MHz
Tx frequency band	GSM850: 824 - 849MHz
	EGSM900: 880 - 915 MHz
	GSM1800: 1710 - 1785 MHz
	GSM1900: 1850 - 1910 MHz
	WCDMA1900: 1850-1910MHz
	WCDMA2100: 1920 - 1980 MHz
Output power	GSM850: +5 ...+33dBm/3.2mW ... 2W
	GSM900: +5 ... +33dBm/3.2mW ... 2W
	GSM1800: +0 ... +30dBm/1.0mW ... 1W
	GSM1900: +0 ... +30dBm/1.0mW ... 1W
	WCDMA -50 ... 24 dBm

Parameter	Unit
Number of RF channels	GSM850: 124
	GSM900: 174
	GSM1800: 374
	GSM1900: 299
Channel spacing	200 kHz
Number of Tx power levels	GSM850: 15
	GSM900: 15
	GSM1800: 16
	GSM1900: 16

Battery endurance

Battery	Capacity (mAh)	Talk time	Stand-by
BP-4L	1500	5 hrs	up to 14 days

Charging times

AC-4
(TBD)

2 — Service Tools and Service Concepts

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Service tools

The table below gives a short overview of service tools that can be used for testing, error analysis and repair of product RA-6, refer to various concepts.

	CA-31D	USB cable	
	The CA-31D USB cable is used to connect FPS-10 or FPS-11 to a PC. It is included in the FPS-10 and FPS-11 sales packages.		
	CA-35S	Power cable	
	CA-35S is a power cable for connecting, for example, the FPS-10 flash prommer to the Point-Of-Sales (POS) flash adapter.		

CU-4	Control unit	

CU-4 is a general service tool used with a module jig and/or a flash adapter. It requires an external 12 V power supply.

The unit has the following features:

- software controlled via USB
- EM calibration function
- Forwards FBUS/Flashbus traffic to/from terminal
- Forwards USB traffic to/from terminal
- software controlled BSI values
- regulated VBATT voltage
- 2 x USB2.0 connector (Hub)
- FBUS and USB connections supported

When using CU-4, note the special order of connecting cables and other service equipment:

Instructions

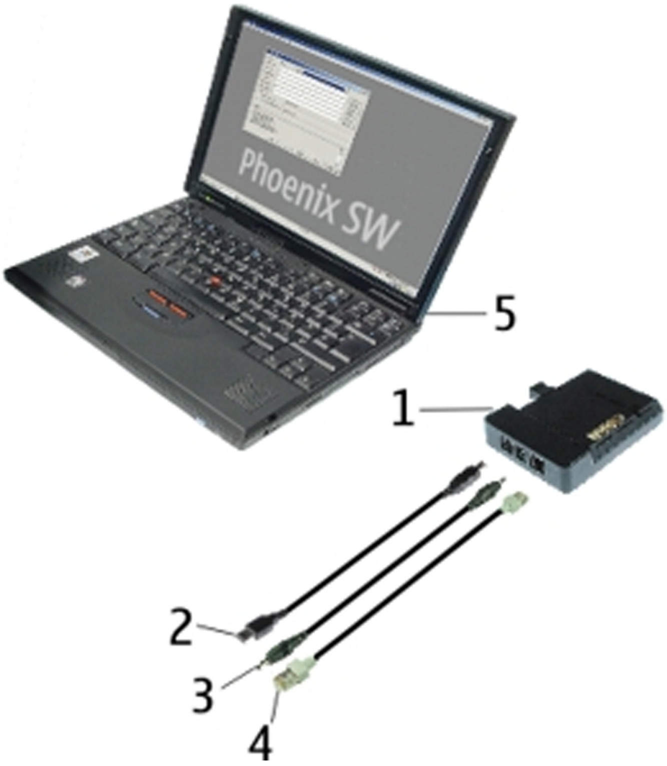
1 Connect a service tool (jig, flash adapter) to CU-4.

2 Connect CU-4 to your PC with a USB cable.

3 Connect supply voltage (12 V)

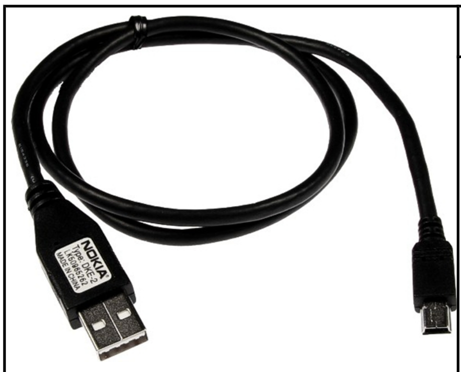
4 Connect an FBUS cable (if necessary).

5 Start Phoenix service software.

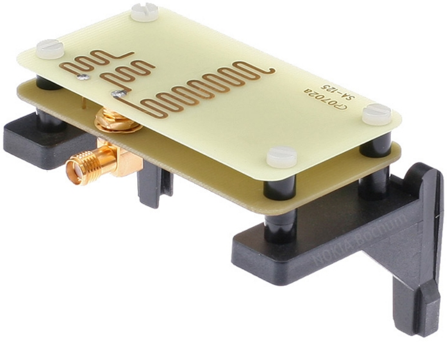
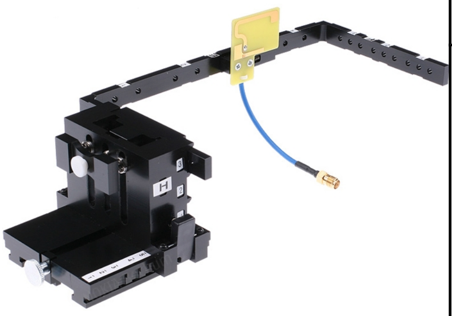


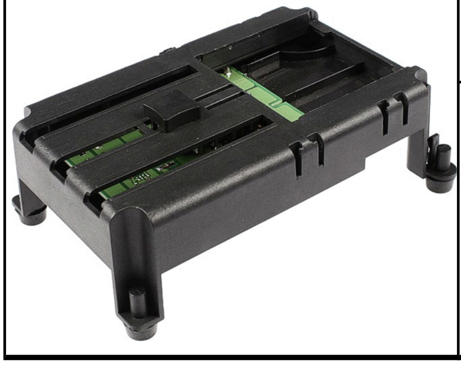
Note: Phoenix enables CU-4 regulators via USB when it is started.

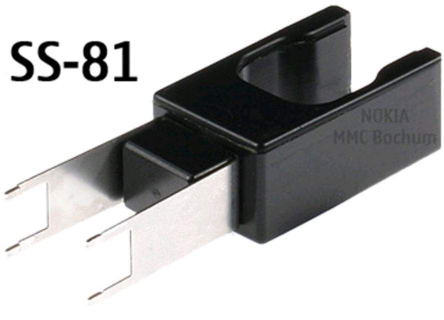
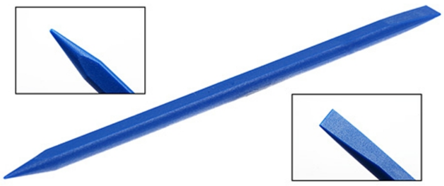
Reconnecting the power supply requires a Phoenix restart.

<table>
<tr><td rowspan="2"></td><td>DKE-2</td><td>Mini-USB cable</td><td></td></tr>
<tr><td colspan="3">USB to mini-USB connector cable.</td></tr>
<tr><td rowspan="2"> </td><td>FLS-5</td><td>Flash device</td><td></td></tr>
<tr><td colspan="3">FLS-5 is a dongle and flash device incorporated into one package, developed specifically for POS use.</td></tr>
<tr><td rowspan="2"> </td><td>FPS-10</td><td>Flash prommer</td><td></td></tr>
<tr><td colspan="3">FPS-10 interfaces with:
• PC
• Control unit
• Flash adapter
• Smart card
FPS-10 flash prommer features:
• Flash functionality for BB5 and DCT-4 terminals
• Smart Card reader for SX-2 or SX-4
• USB traffic forwarding
• USB to FBUS/Flashbus conversion
• LAN to FBUS/Flashbus and USB conversion
• Vusb output switchable by PC command
FPS-10 sales package includes:
• FPS-10 prommer
• Power Supply with 5 country specific cords
• USB cable</td></tr>
</table>

<table>
<tr><td rowspan="2"> </td><td>FS-49</td><td>Flash adapter</td><td></td></tr>
<tr><td colspan="3">Flash adapter FS-49 is used for phone testing and flashing. FS-49 is used with the generic flash adapter base SS-60/62 and control unit CU-4 or interface adapter SS-46.
When flashing or system testing the phone, the adapter is attached to replace the phone own battery.
All functions (as well as the calibration voltages, current and the protections for over voltages, over current and voltage polarity), are performed by CU-4.
Flash adapter FS-49 main features:
• VBATT supply interface
• USB / FBUS multiplexed interface to the phone</td></tr>
<tr><td rowspan="2"> </td><td>MJ-115</td><td>Module jig</td><td></td></tr>
<tr><td colspan="3">MJ-115 can be used for flashing as well as for RF, battery and system testing.
MJ-115 main functions:
• CU-4 interface adapter to phone
• FBUS interface to phone
• UI Interface to phone
• WCDMA and GSM RF-interface
All functions are performed in CU-4 e.g. calibration voltages and currents both all protections (over current, over voltage and voltage polarity).
MJ-115 contains following interfaces to phone:
• VBATT interface
• UI interface containing Display connector
• WCDMA and GSM RF interfaces
• Bluetooth RF interface
• Earpiece interface
• IHF speaker interface
• Microphone interface</td></tr>
<tr><td rowspan="2"> </td><td>PCS-1</td><td>Power cable</td><td></td></tr>
<tr><td colspan="3">The PCS-1 power cable (DC) is used with a docking station, a module jig or a control unit to supply a controlled voltage.</td></tr>
</table>

	PKD-1	SW security device	
	SW security device is a piece of hardware enabling the use of the service software when connected to the parallel (LPT) port of the PC. Without the device, it is not possible to use the service software. Printer or any such device can be connected to the PC through the device if needed.		
	RJ-150	Soldering jig	
	RJ-150 is a soldering jig used for soldering and as a rework jig for the engine module.		
	SA-125	RF coupler	
	SA-125 is an RF coupler for WCDMA and GSM RF testing. It is used together with the product-specific flash adapter.		
	SA-131	RF coupler	
	SA-131 is a generic device for GPS testing.		
NOKIA CLASS 1 STATUS BER TEST FBUS POWER	SB-6	Bluetooth tester	
	The SB-6 test box is a generic device to perform Bluetooth bit error rate testing and doing cordless FBUS connection via Bluetooth.		

	SB-7	WLAN test box	
	WLAN test requires defined position for the device.		
	SRT-6	Opening tool	
	SRT-6 is used to open phone covers.		
	SS-46	Interface adapter	
	SS-46 acts as an interface adapter between the flash adapter and FPS-10.		
	SS-62	Generic flash adapter base for BB5	
	• generic base for flash adapters and couplers • SS-62 equipped with a clip interlock system • provides standardised interface towards Control Unit • provides RF connection using galvanic connector or coupler • multiplexing between USB and FBUS media, controlled by VUSB		

	SS-81	Camera removal tool	
	Camera removal tool for main camera.		
	SS-93	Opening tool	
	SS-93 is used for opening JAE connectors.		
	SX-4	Smart card	
	SX-4 is a BB5 security device used to protect critical features in tuning and testing. SX-4 is also needed together with FPS-10 when DCT-4 phones are flashed.		
	XCS-4	Modular cable	
	XCS-4 is a shielded (one specially shielded conductor) modular cable for flashing and service purposes.		
	XRS-6	RF cable	
	The RF cable is used to connect, for example, a module repair jig to the RF measurement equipment. SMA to N-Connector approximately 610 mm. Attenuation for: • GSM850/900: 0.3+-0.1 dB • GSM1800/1900: 0.5+-0.1 dB • WLAN: 0.6+-0.1dB		

Service concepts

POS (Point of Sale) flash concept

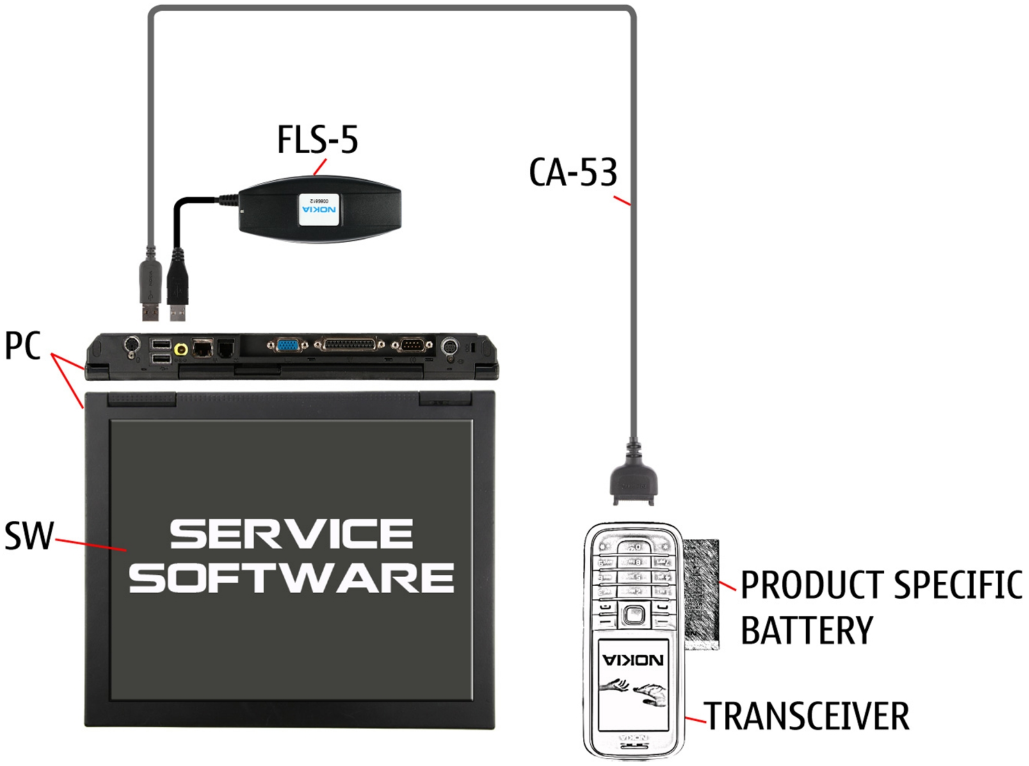

FLS-5
CA-53
PC
SW
SERVICE SOFTWARE
PRODUCT SPECIFIC BATTERY
TRANSCEIVER

Figure 2 POS flash concept

Type	Description
Product specific tools	
BP-4L	Battery
Other tools	
FLS-5	POS flash dongle
	PC with Phoenix service software
Cables	
CA-53	USB connectivity cable

POS (Point of Sale) flash concept

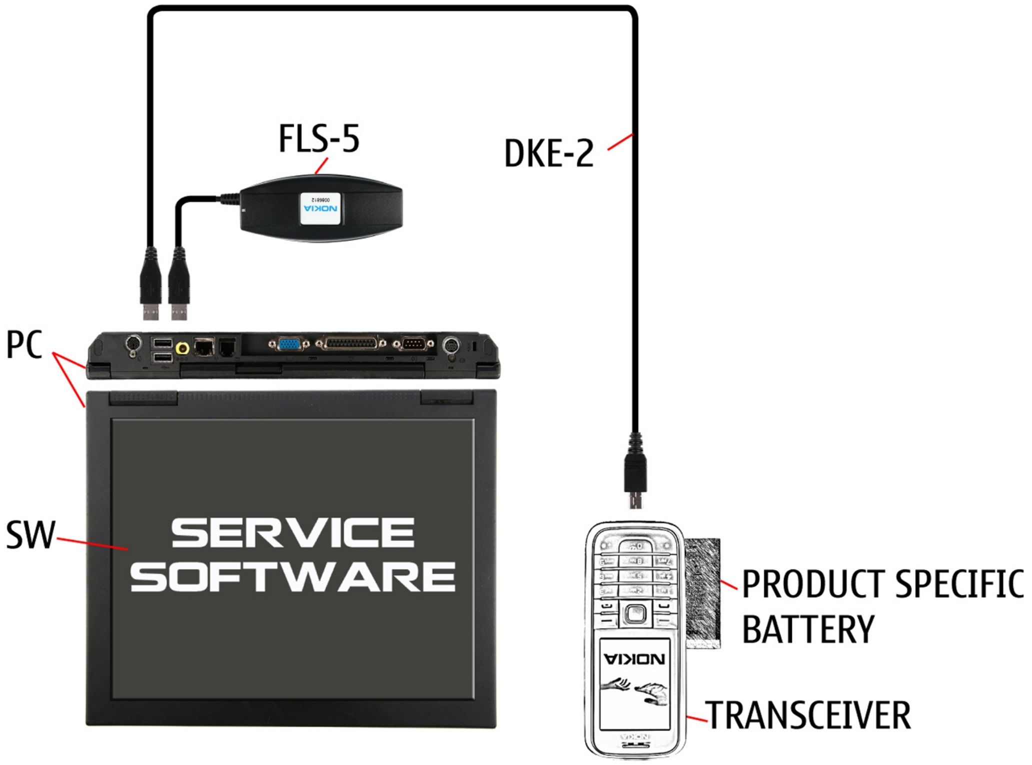

FLS-5
DKE-2
PC
SW
SERVICE SOFTWARE
PRODUCT SPECIFIC BATTERY
TRANSCEIVER

Figure 3 POS flash concept

Type	Description
Product specific tools	
BP-4L	Battery
Other tools	
FLS-5	POS flash dongle
	PC with Phoenix service software
Cables	
DKE-2	USB connectivity cable

Module jig service concept

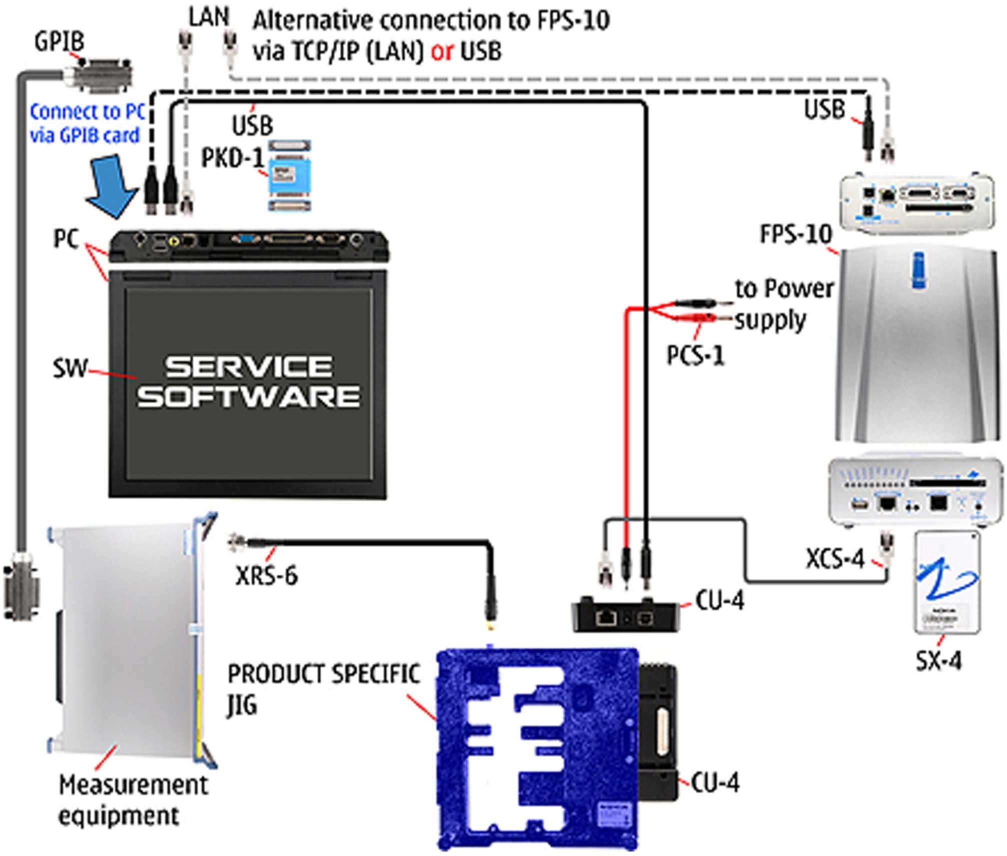

LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
GPIB
Connect to PC
via GPIB card
USB
PKD-1
USB
FPS-10
PC
to Power
supply
PCS-1
SW
SERVICE
SOFTWARE
XRS-6
XCS-4
CU-4
SX-4
PRODUCT SPECIFIC
JIG
Measurement
equipment
CU-4

Figure 4 Module jig service concept

Type	Description
Phone specific devices	
MJ-115	Module jig
Other devices	
CU-4	Control unit
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SX-4	Smart card
	PC with Phoenix service software
	Measurement equipment
Cables	
PCS-1	DC power cable
XCS-4	Modular cable
XRS-6	RF cable
	USB cable

Type	Description
	GPIB control cable

Service concept for RF testing and RF/BB tuning

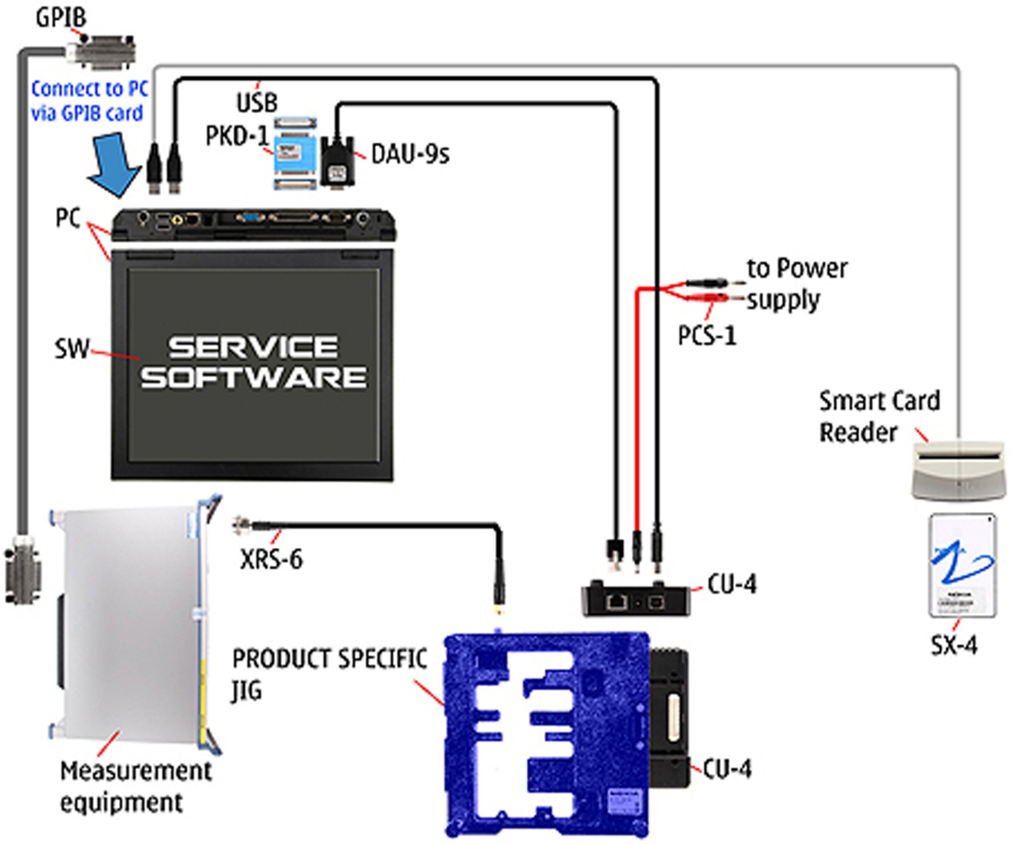

GPIB
Connect to PC via GPIB card
USB
PKD-1
DAU-9s
PC
SW
SERVICE SOFTWARE
to Power supply
PCS-1
Smart Card Reader
XRS-6
CU-4
SX-4
PRODUCT SPECIFIC JIG
Measurement equipment
CU-4

Figure 5 Service concept for RF testing and RF/BB tuning

Type	Description
Product specific devices	
MJ-115	Module jig
Other devices	
CU-4	Control unit
PKD-1/PK-1	SW security device
SX-4	Smart card
	Measurement equipment
	Smart card reader
	PC with Phoenix service software
Cables	
DAU-9s	MBUS cable
PCS-1	DC power cable

Type	Description
XRS-6	RF cable
	GPIB control cable
	USB cable

Flash concept with FPS-10

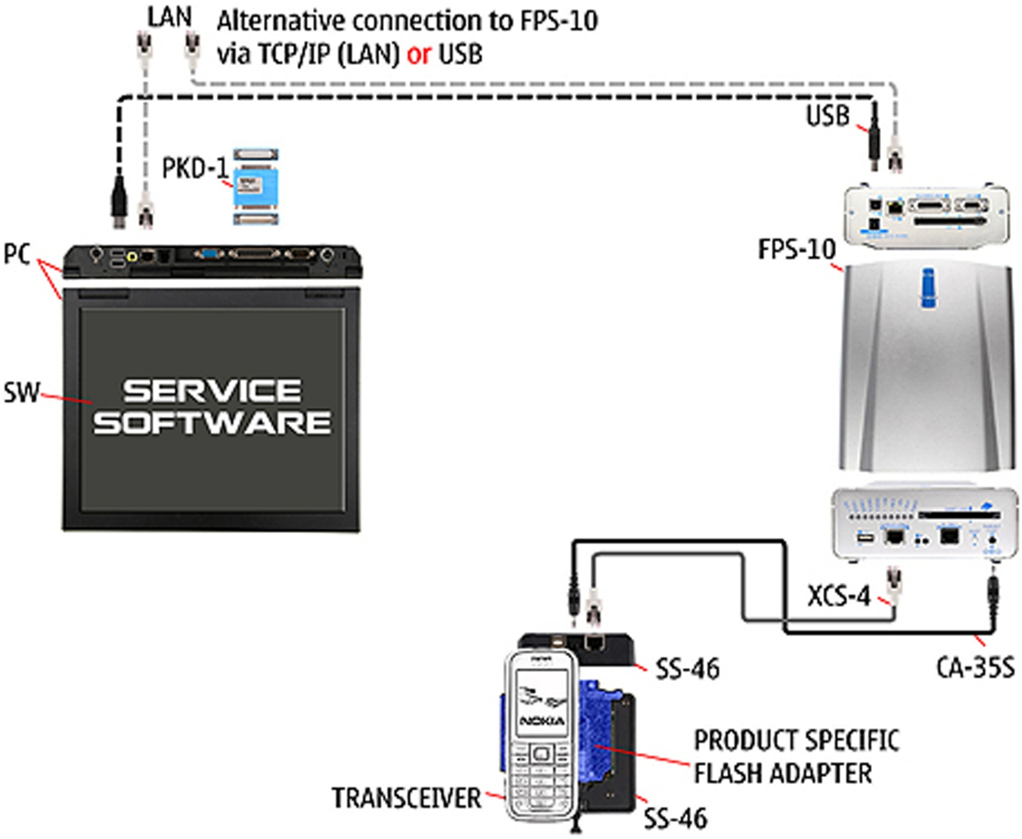

LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
USB
PKD-1
PC
SW
SERVICE
SOFTWARE
FPS-10
XCS-4
SS-46
CA-35S
PRODUCT SPECIFIC
FLASH ADAPTER
TRANSCEIVER
SS-46

Figure 6 Basic flash concept with FPS-10

Type	Description
Product specific devices	
FS-49	Flash adapter
Other devices	
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-46	Interface adapter
	PC with Phoenix service software
Cables	
XCS-4	Modular cable
CA-35S	Power cable

Type	Description
	USB cable

RF testing concept with RF coupler

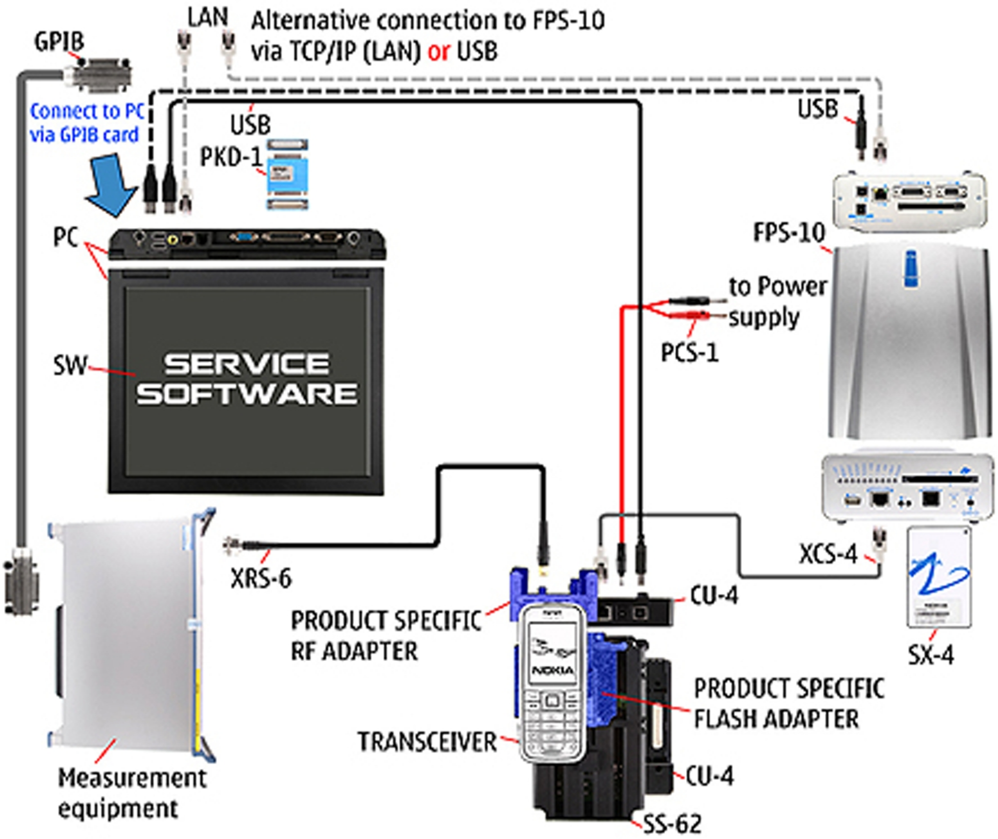

LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
GPIB
Connect to PC
via GPIB card
USB
PKD-1
USB
PC
FPS-10
to Power
supply
PCS-1
SW
SERVICE
SOFTWARE
XRS-6
XCS-4
PRODUCT SPECIFIC
RF ADAPTER
CU-4
SX-4
PRODUCT SPECIFIC
FLASH ADAPTER
TRANSCEIVER
CU-4
Measurement
equipment
SS-62

Figure 7 RF testing concept with RF coupler

Type	Description
Product specific devices	
FS-49	Flash adapter
SA-125	RF coupler
Other devices	
CU-4	Control unit
SX-4	Smart card
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-62	Flash adapter base
	Measurement equipment
	PC with Phoenix service software
Cables	
PCS-1	Power cable

Type	Description
XCS-4	Modular cable
XRS-6	RF cable
	GPIB control cable
	USB cable

CU-4 flash concept with FPS-10

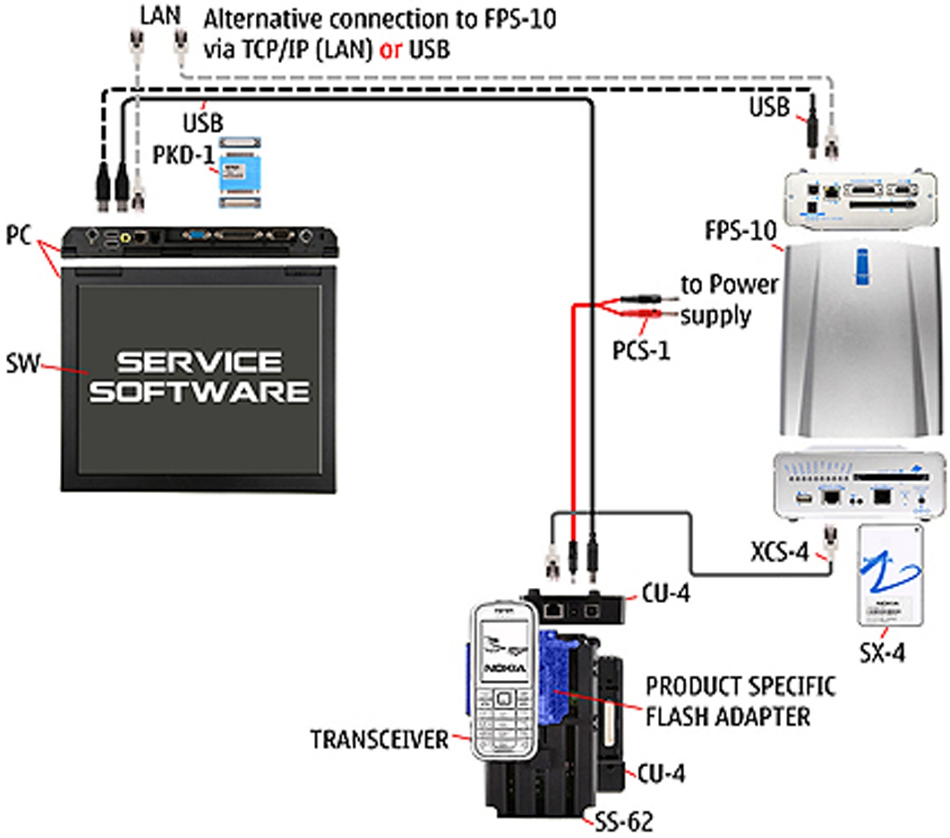

LAN
Alternative connection to FPS-10 via TCP/IP (LAN) or USB
USB
PKD-1
USB
PC
FPS-10
to Power supply
PCS-1
SW
SERVICE SOFTWARE
XCS-4
CU-4
SX-4
PRODUCT SPECIFIC FLASH ADAPTER
TRANSCEIVER
CU-4
SS-62

Figure 8 CU-4 flash concept with FPS-10

Type	Description
Product specific devices	
FS-49	Flash adapter
Other devices	
CU-4	Control unit
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-62	Flash adapter base
SX-4	Smart card
	PC with Phoenix service software
Cables	

Type	Description
PCS-1	Power cable
XCS-4	Modular cable
	Standard USB cable
	USB cable

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3 — BB Troubleshooting and Tuning Guide

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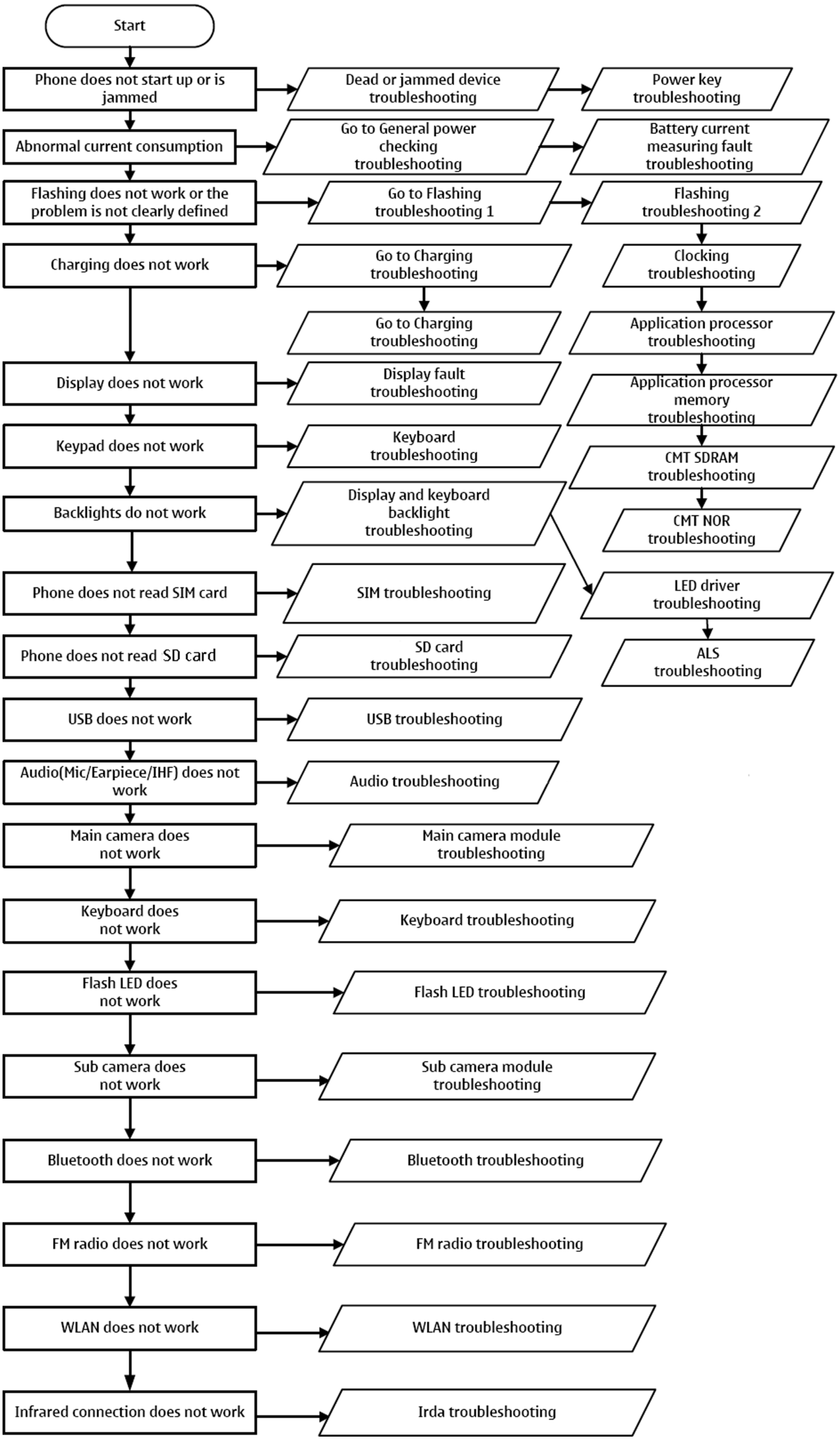
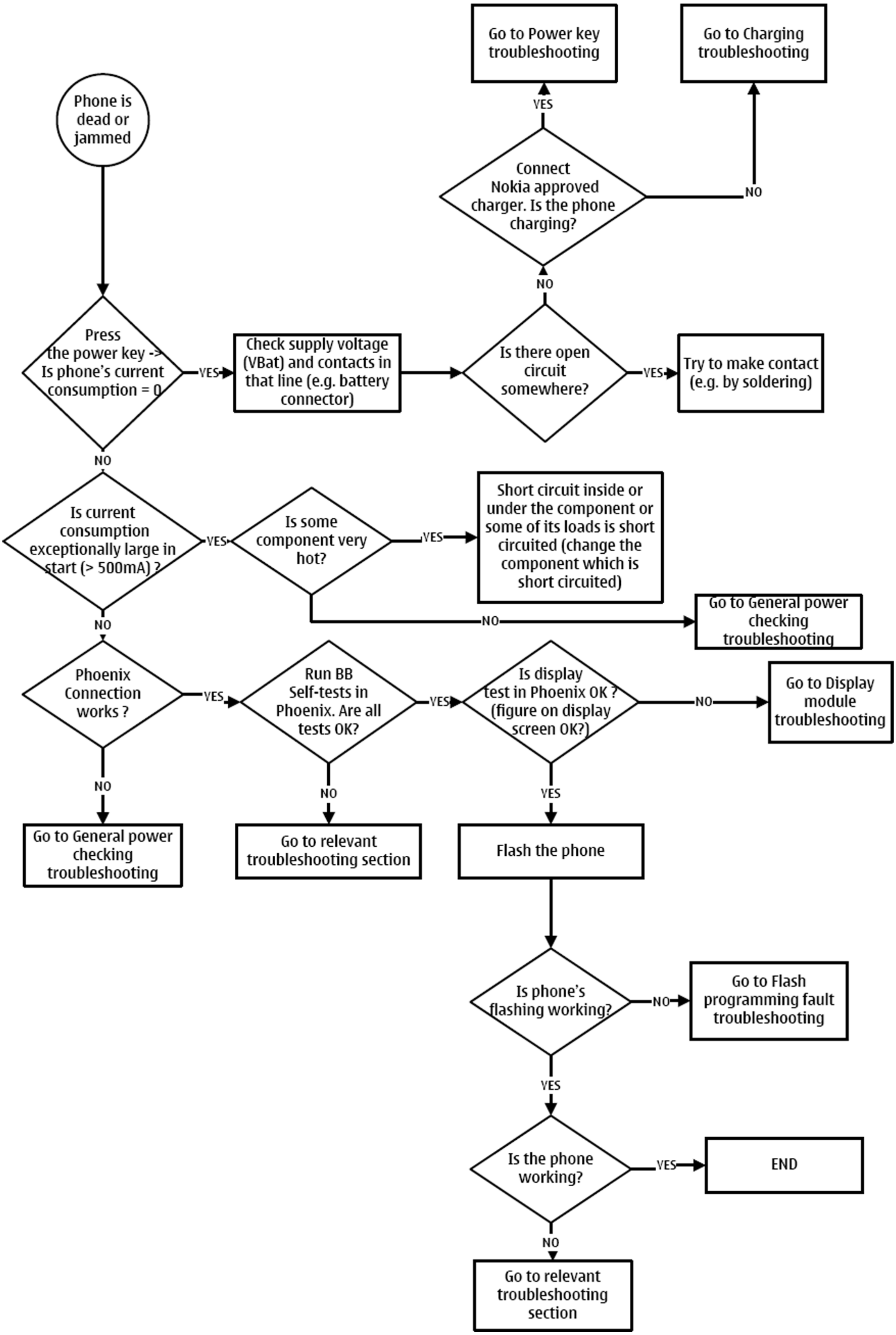
Baseband troubleshooting

Troubleshooting flow


Start
Phone does not start up or is jammed
Dead or jammed device troubleshooting
Power key troubleshooting
Abnormal current consumption
Go to General power checking troubleshooting
Battery current measuring fault troubleshooting
Flashing does not work or the problem is not clearly defined
Go to Flashing troubleshooting 1
Flashing troubleshooting 2
Charging does not work
Go to Charging troubleshooting
Clocking troubleshooting
Go to Charging troubleshooting
Application processor troubleshooting
Display does not work
Display fault troubleshooting
Application processor memory troubleshooting
Keypad does not work
Keyboard troubleshooting
CMT SDRAM troubleshooting
Backlights do not work
Display and keyboard backlight troubleshooting
CMT NOR troubleshooting
Phone does not read SIM card
SIM troubleshooting
LED driver troubleshooting
Phone does not read SD card
SD card troubleshooting
ALS troubleshooting
USB does not work
USB troubleshooting
Audio(Mic/Earpiece/IHF) does not work
Audio troubleshooting
Main camera does not work
Main camera module troubleshooting
Keyboard does not work
Keyboard troubleshooting
Flash LED does not work
Flash LED troubleshooting
Sub camera does not work
Sub camera module troubleshooting
Bluetooth does not work
Bluetooth troubleshooting
FM radio does not work
FM radio troubleshooting
WLAN does not work
WLAN troubleshooting
Infrared connection does not work
Irda troubleshooting

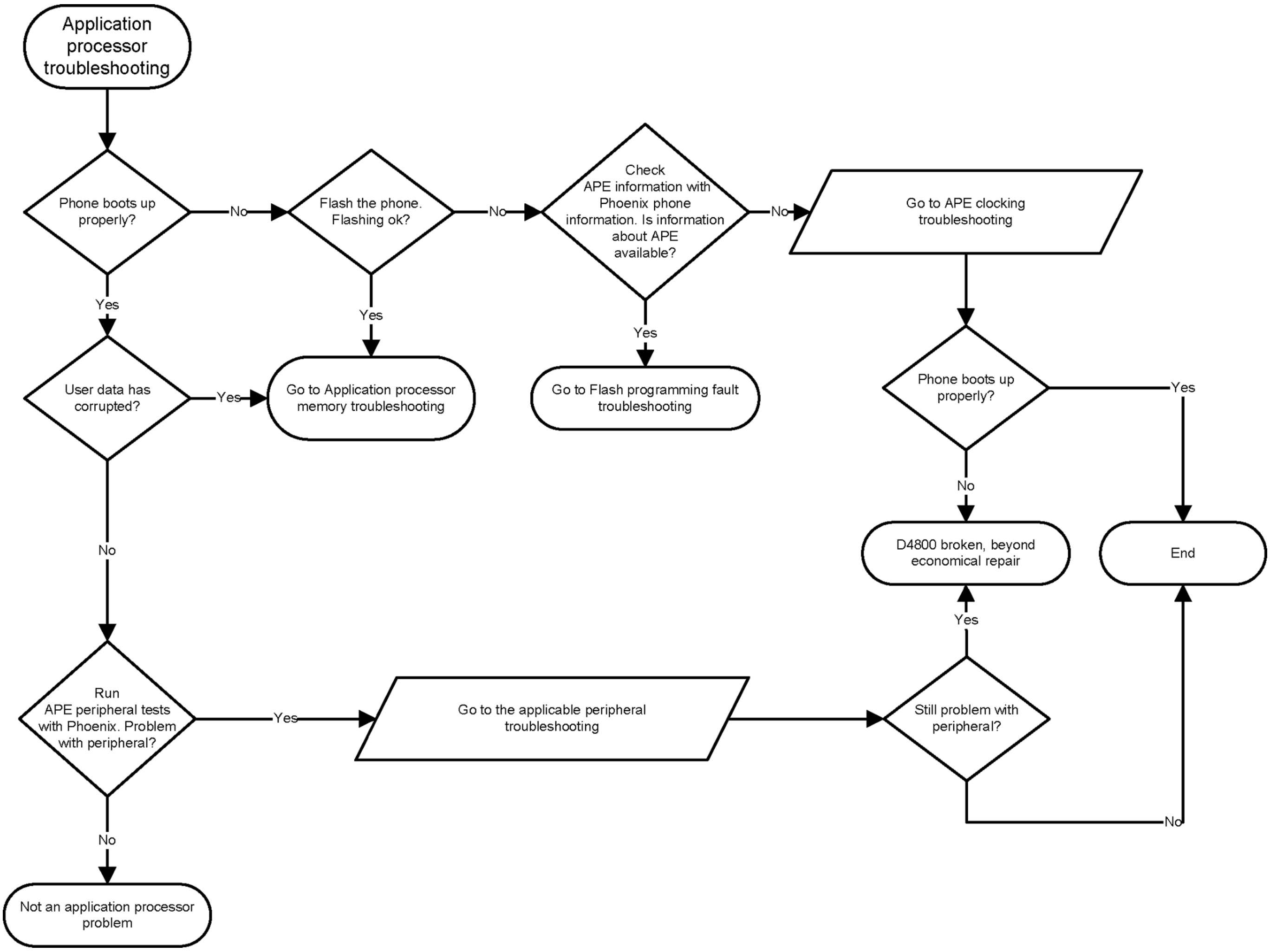
Dead or jammed device troubleshooting

Troubleshooting flow


Phone is dead or jammed
Press the power key -> Is phone's current consumption = 0
YES
Check supply voltage (VBat) and contacts in that line (e.g. battery connector)
Is there open circuit somewhere?
YES
Try to make contact (e.g. by soldering)
NO
Connect Nokia approved charger. Is the phone charging?
YES
Go to Power key troubleshooting
NO
Go to Charging troubleshooting
NO
Is current consumption exceptionally large in start (> 500mA) ?
YES
Is some component very hot?
YES
Short circuit inside or under the component or some of its loads is short circuited (change the component which is short circuited)
NO
Go to General power checking troubleshooting
NO
Phoenix Connection works ?
NO
Go to General power checking troubleshooting
YES
Run BB Self-tests in Phoenix. Are all tests OK?
NO
Go to relevant troubleshooting section
YES
Is display test in Phoenix OK ? (figure on display screen OK?)
NO
Go to Display module troubleshooting
YES
Flash the phone
Is phone's flashing working?
NO
Go to Flash programming fault troubleshooting
YES
Is the phone working?
YES
END
NO
Go to relevant troubleshooting section

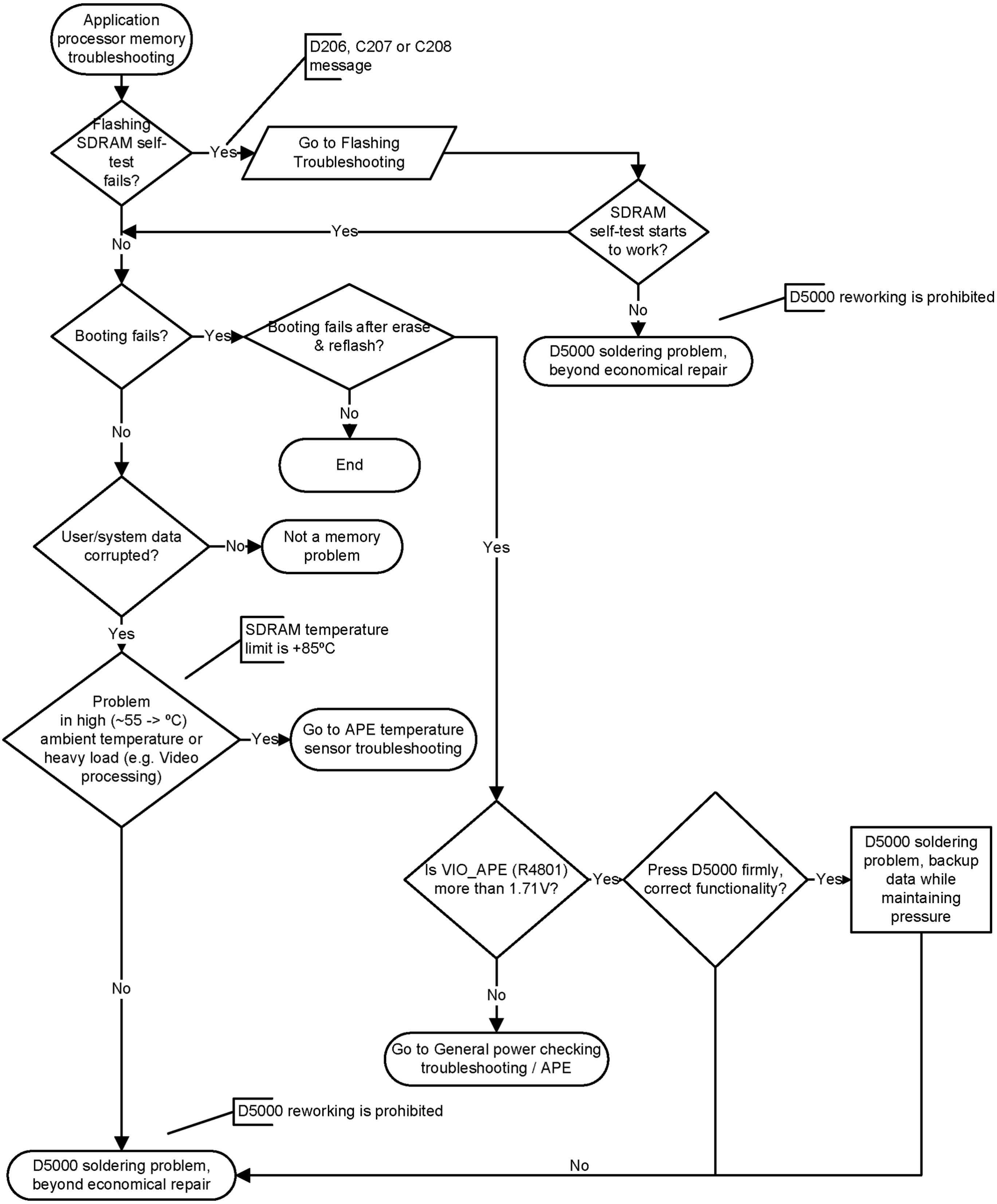
APE CPU troubleshooting

Troubleshooting flow


Application processor troubleshooting
Phone boots up properly?
No
Flash the phone. Flashing ok?
No
Check APE information with Phoenix phone information. Is information about APE available?
No
Go to APE clocking troubleshooting
Yes
Yes
Yes
User data has corrupted?
Yes
Go to Application processor memory troubleshooting
Go to Flash programming fault troubleshooting
Phone boots up properly?
Yes
No
D4800 broken, beyond economical repair
End
No
Yes
Run APE peripheral tests with Phoenix. Problem with peripheral?
Yes
Go to the applicable peripheral troubleshooting
Still problem with peripheral?
No
No
Not an application processor problem

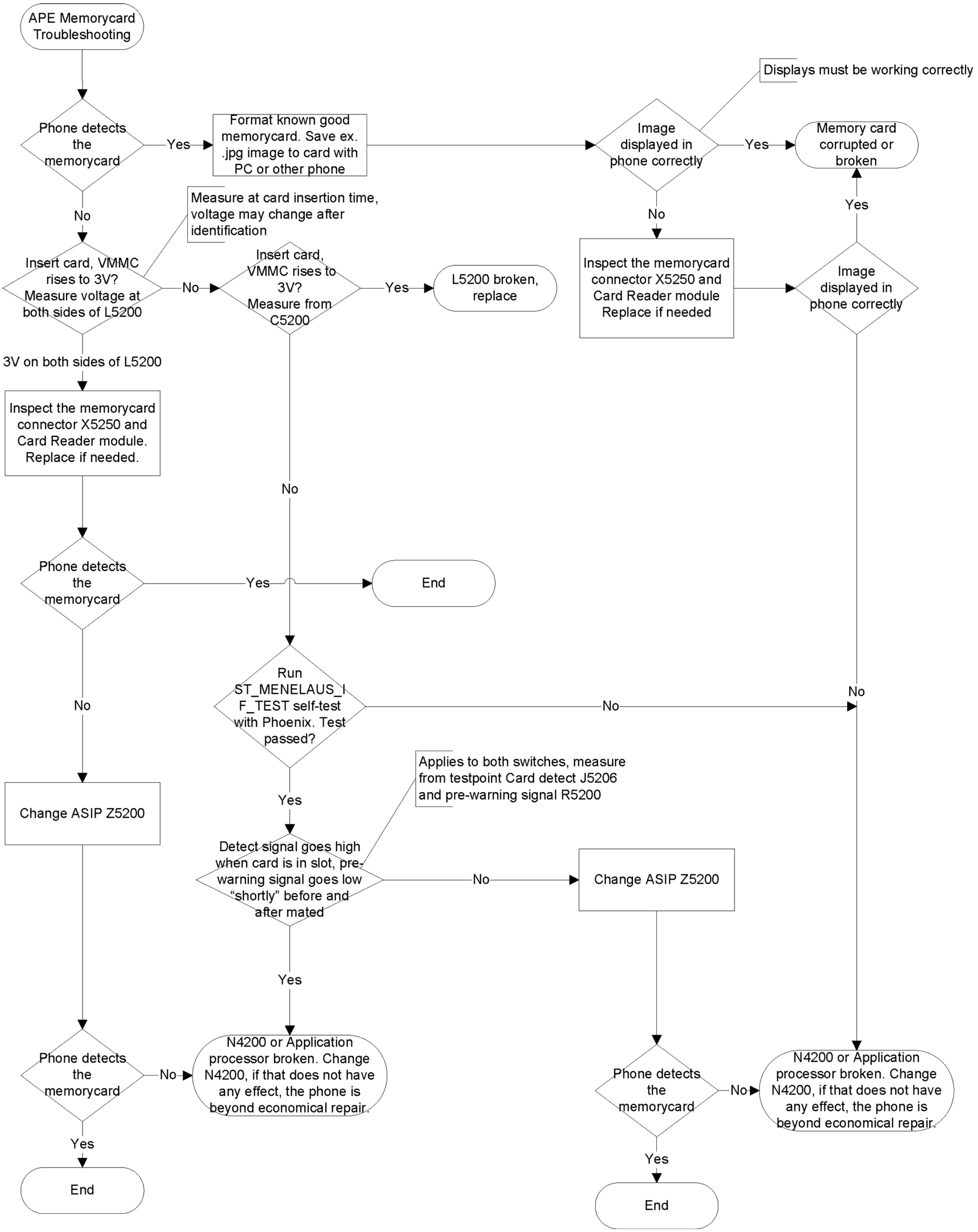
APE memory troubleshooting

Troubleshooting flow


Application processor memory troubleshooting
D206, C207 or C208 message
Flashing SDRAM self-test fails?
Yes
Go to Flashing Troubleshooting
SDRAM self-test starts to work?
Yes
No
No
D5000 reworking is prohibited
Booting fails?
Yes
Booting fails after erase & reflash?
D5000 soldering problem, beyond economical repair
No
No
End
User/system data corrupted?
No
Not a memory problem
Yes
Yes
SDRAM temperature limit is +85°C
Problem in high (~55 -> °C) ambient temperature or heavy load (e.g. Video processing)
Yes
Go to APE temperature sensor troubleshooting
Is VIO_APE (R4801) more than 1.71V?
Yes
Press D5000 firmly, correct functionality?
Yes
D5000 soldering problem, backup data while maintaining pressure
No
No
Go to General power checking troubleshooting / APE
D5000 reworking is prohibited
No
D5000 soldering problem, beyond economical repair

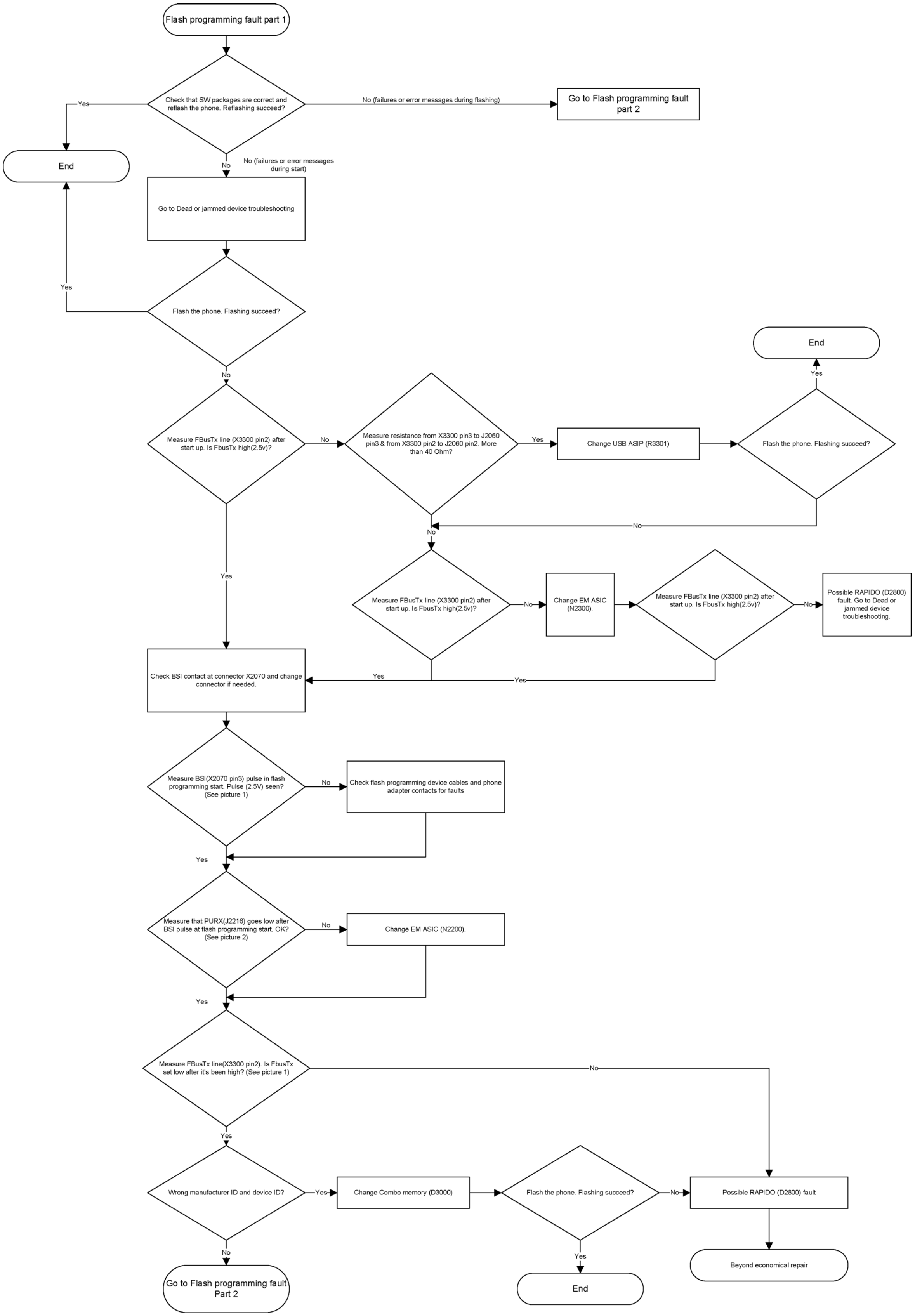
APE memorycard troubleshooting

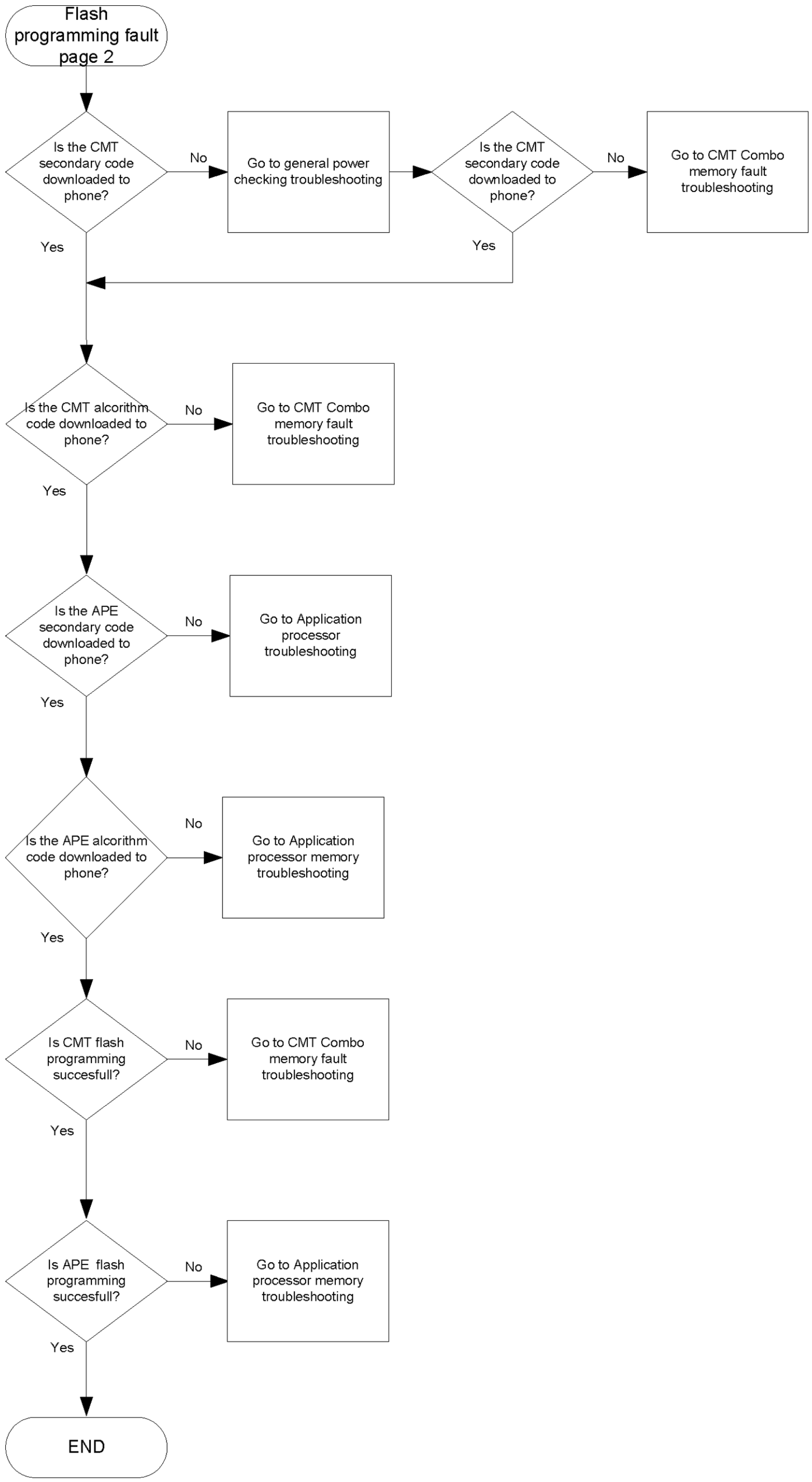
Troubleshooting flow


APE Memorycard Troubleshooting
Phone detects the memorycard
Yes
Format known good memorycard. Save ex. .jpg image to card with PC or other phone
Displays must be working correctly
Image displayed in phone correctly
Yes
Memory card corrupted or broken
No
Measure at card insertion time, voltage may change after identification
Insert card, VMMC rises to 3V? Measure voltage at both sides of L5200
No
Insert card, VMMC rises to 3V? Measure from C5200
Yes
L5200 broken, replace
No
Inspect the memorycard connector X5250 and Card Reader module Replace if needed
Image displayed in phone correctly
Yes
3V on both sides of L5200
Inspect the memorycard connector X5250 and Card Reader module. Replace if needed.
No
Phone detects the memorycard
Yes
End
No
Run ST_MENELAUS_IF_TEST self-test with Phoenix. Test passed?
No
No
Change ASIP Z5200
Yes
Applies to both switches, measure from testpoint Card detect J5206 and pre-warning signal R5200
Detect signal goes high when card is in slot, pre-warning signal goes low “shortly” before and after mated
No
Change ASIP Z5200
Yes
Phone detects the memorycard
No
N4200 or Application processor broken. Change N4200, if that does not have any effect, the phone is beyond economical repair.
Yes
End
Phone detects the memorycard
No
N4200 or Application processor broken. Change N4200, if that does not have any effect, the phone is beyond economical repair.
Yes
End

Flash programming 1 and 2

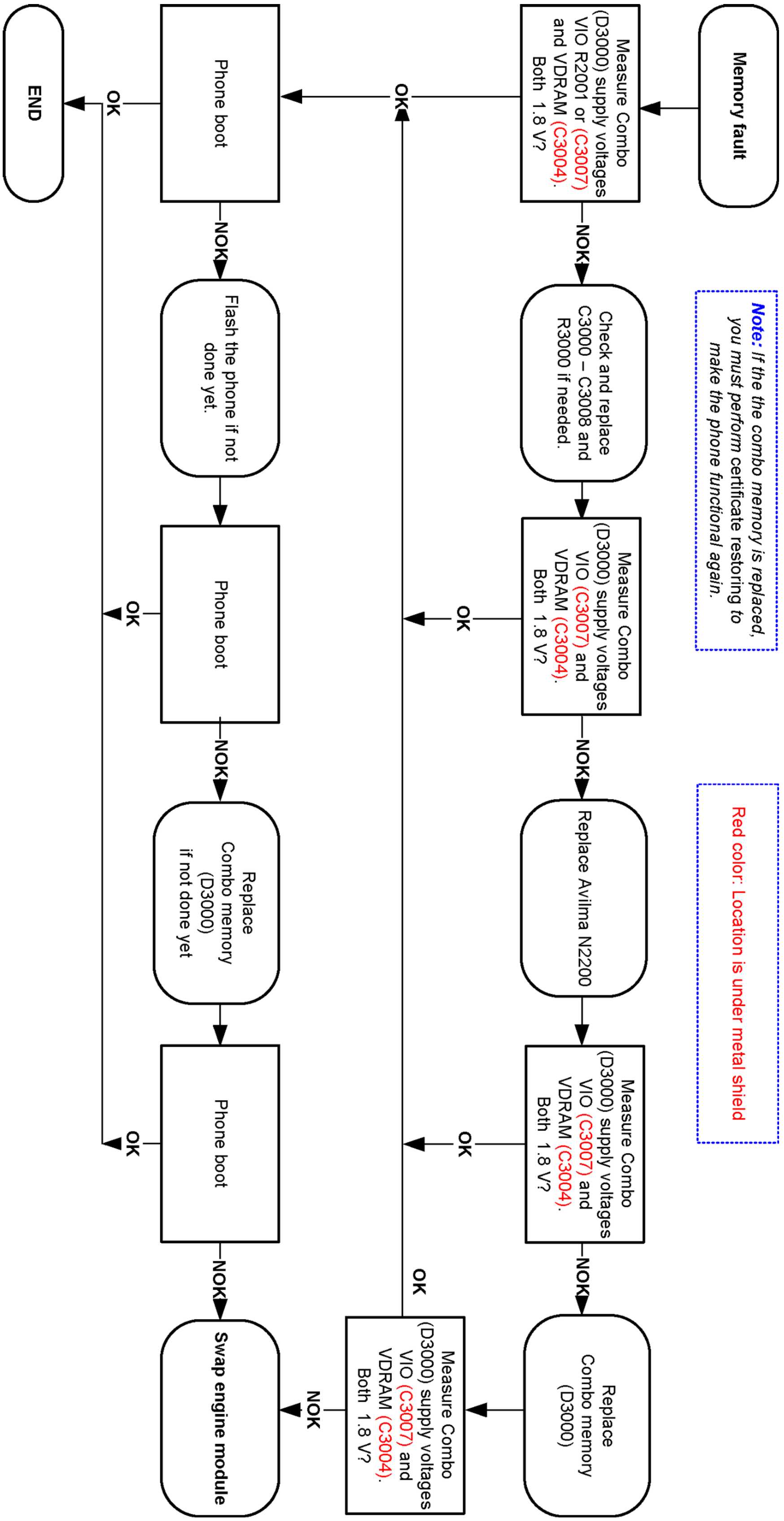
Troubleshooting flow


Flash programming fault part 1
Check that SW packages are correct and reflash the phone. Reflashing succeed?
Yes
End
No (failures or error messages during flashing)
Go to Flash programming fault part 2
No
No (failures or error messages during start)
Go to Dead or jammed device troubleshooting
Flash the phone. Flashing succeed?
Yes
No
Measure FBusTx line (X3300 pin2) after start up. Is FbusTx high(2.5v)?
No
Measure resistance from X3300 pin3 to J2060 pin3 & from X3300 pin2 to J2060 pin2. More than 40 Ohm?
Yes
Change USB ASIP (R3301)
Flash the phone. Flashing succeed?
Yes
End
No
No
Yes
Measure FBusTx line (X3300 pin2) after start up. Is FbusTx high(2.5v)?
No
Change EM ASIC (N2300).
Measure FBusTx line (X3300 pin2) after start up. Is FbusTx high(2.5v)?
No
Possible RAPIDO (D2800) fault. Go to Dead or jammed device troubleshooting.
Yes
Yes
Check BSI contact at connector X2070 and change connector if needed.
Measure BSI(X2070 pin3) pulse in flash programming start. Pulse (2.5V) seen? (See picture 1)
No
Check flash programming device cables and phone adapter contacts for faults
Yes
Measure that PURX(J2216) goes low after BSI pulse at flash programming start. OK? (See picture 2)
No
Change EM ASIC (N2200).
Yes
Measure FBusTx line(X3300 pin2). Is FbusTx set low after it's been high? (See picture 1)
No
Yes
Wrong manufacturer ID and device ID?
Yes
Change Combo memory (D3000)
Flash the phone. Flashing succeed?
No
Possible RAPIDO (D2800) fault
Beyond economical repair
No
Go to Flash programming fault Part 2
Yes
End


Flash programming fault page 2
Is the CMT secondary code downloaded to phone?
No
Go to general power checking troubleshooting
Is the CMT secondary code downloaded to phone?
No
Go to CMT Combo memory fault troubleshooting
Yes
Yes
Is the CMT alcorithm code downloaded to phone?
No
Go to CMT Combo memory fault troubleshooting
Yes
Is the APE secondary code downloaded to phone?
No
Go to Application processor troubleshooting
Yes
Is the APE alcorithm code downloaded to phone?
No
Go to Application processor memory troubleshooting
Yes
Is CMT flash programming succesfull?
No
Go to CMT Combo memory fault troubleshooting
Yes
Is APE flash programming succesfull?
No
Go to Application processor memory troubleshooting
Yes
END

Combo memory troubleshooting

Troubleshooting flow

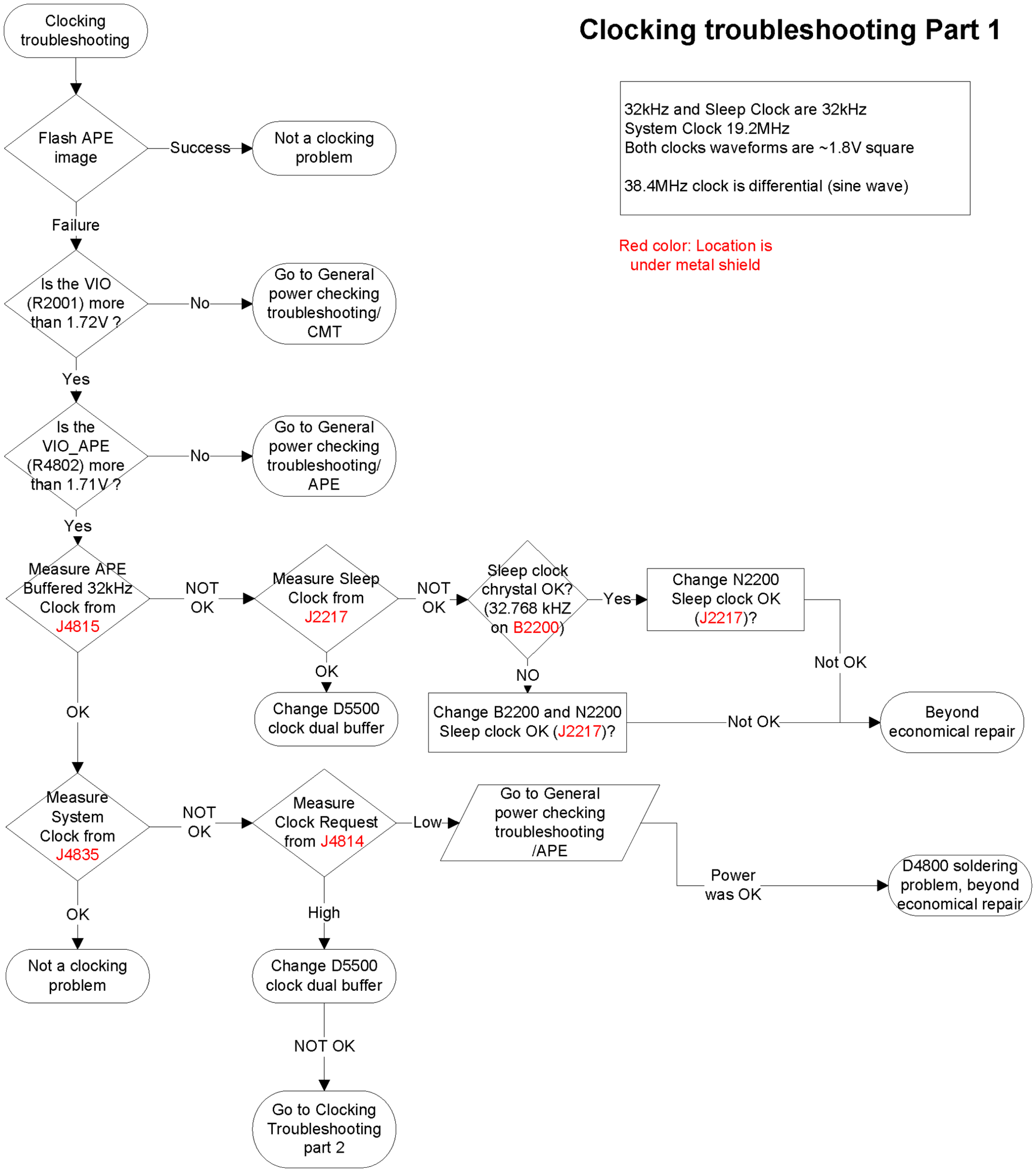

Memory fault
Measure Combo (D3000) supply voltages VIO R2001 or (C3007) and VDRAM (C3004). Both 1.8 V?
OK
NOK
Check and replace C3000 – C3008 and R3000 if needed.
Measure Combo (D3000) supply voltages VIO (C3007) and VDRAM (C3004). Both 1.8 V?
OK
NOK
Replace Avilma N2200
Measure Combo (D3000) supply voltages VIO (C3007) and VDRAM (C3004). Both 1.8 V?
OK
NOK
Replace Combo memory (D3000)
Measure Combo (D3000) supply voltages VIO (C3007) and VDRAM (C3004). Both 1.8 V?
OK
NOK
Phone boot
OK
NOK
Flash the phone if not done yet.
Phone boot
OK
NOK
Replace Combo memory (D3000) if not done yet
Phone boot
OK
NOK
Swap engine module
END

***Note:** If the the combo memory is replaced, you must perform certificate restoring to make the phone functional again.*

Red color: Location is under metal shield

Clocking troubleshooting 1 and 2

Troubleshooting flow

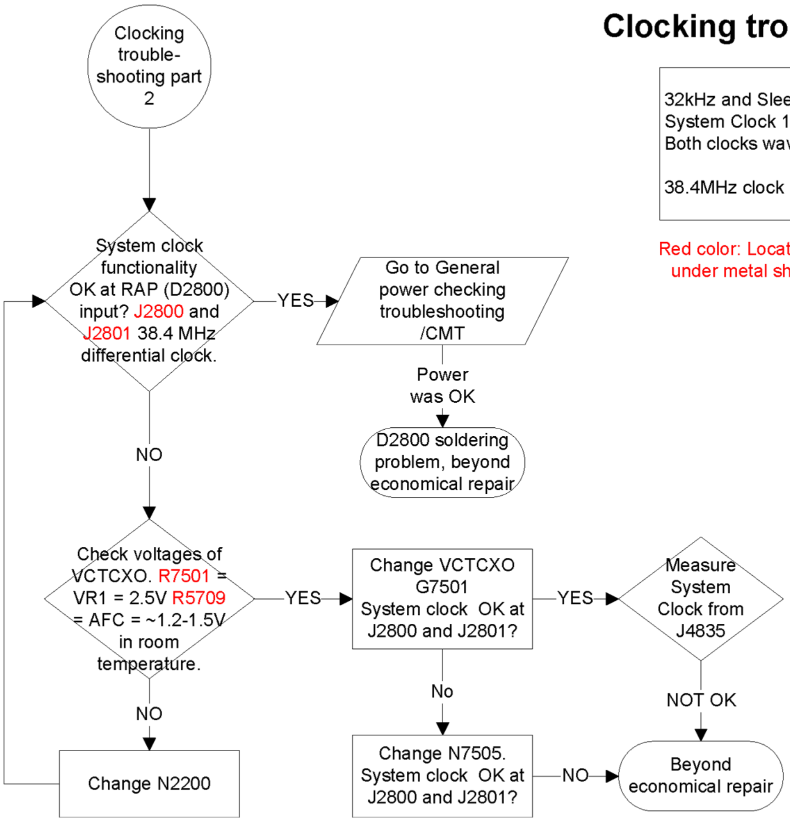

Clocking troubleshooting Part 1
32kHz and Sleep Clock are 32kHz
System Clock 19.2MHz
Both clocks waveforms are ~1.8V square
38.4MHz clock is differential (sine wave)
Red color: Location is under metal shield
Clocking troubleshooting
Flash APE image
Success
Not a clocking problem
Failure
Is the VIO (R2001) more than 1.72V ?
No
Go to General power checking troubleshooting/ CMT
Yes
Is the VIO_APE (R4802) more than 1.71V ?
No
Go to General power checking troubleshooting/ APE
Yes
Measure APE Buffered 32kHz Clock from J4815
NOT OK
Measure Sleep Clock from J2217
NOT OK
Sleep clock chrystal OK? (32.768 kHZ on B2200)
Yes
Change N2200 Sleep clock OK (J2217)?
Not OK
OK
Change D5500 clock dual buffer
NO
Change B2200 and N2200 Sleep clock OK (J2217)?
Not OK
Beyond economical repair
OK
Measure System Clock from J4835
NOT OK
Measure Clock Request from J4814
Low
Go to General power checking troubleshooting /APE
Power was OK
D4800 soldering problem, beyond economical repair
OK
Not a clocking problem
High
Change D5500 clock dual buffer
NOT OK
Go to Clocking Troubleshooting part 2

Clocking troubleshooting Part 2

32kHz and Sleep Clock are 32kHz
System Clock 19.2MHz
Both clocks waveforms are ~1.8V square

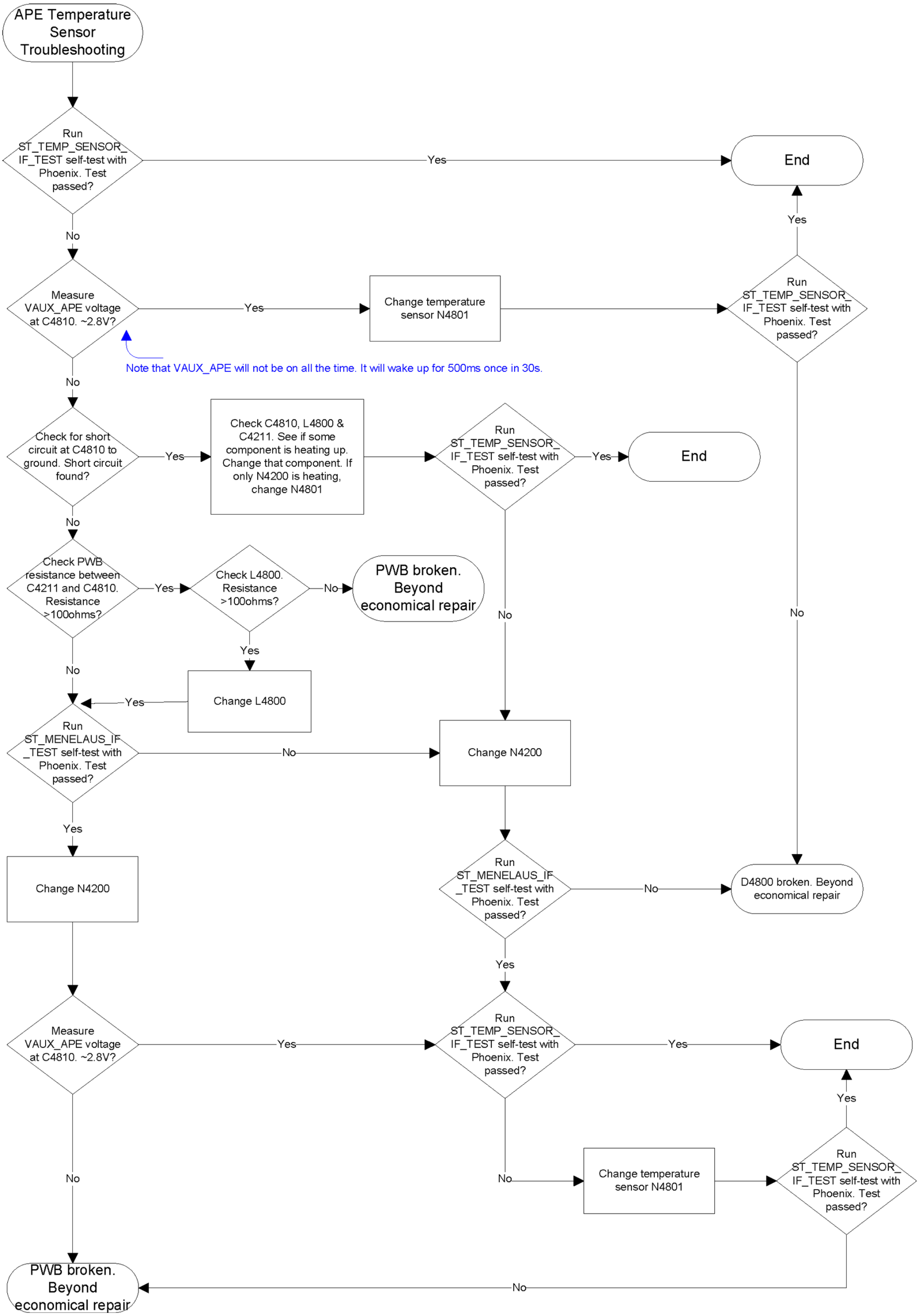
38.4MHz clock is differential (sine wave)

Red color: Location is under metal shield


Clocking trouble-shooting part 2
System clock functionality OK at RAP (D2800) input? J2800 and J2801 38.4 MHz differential clock.
YES
Go to General power checking troubleshooting /CMT
Power was OK
D2800 soldering problem, beyond economical repair
NO
Check voltages of VCTCXO. R7501 = VR1 = 2.5V R5709 = AFC = ~1.2-1.5V in room temperature.
YES
Change VCTCXO G7501 System clock OK at J2800 and J2801?
YES
Measure System Clock from J4835
NOT OK
Beyond economical repair
No
Change N7505. System clock OK at J2800 and J2801?
NO
NO
Change N2200

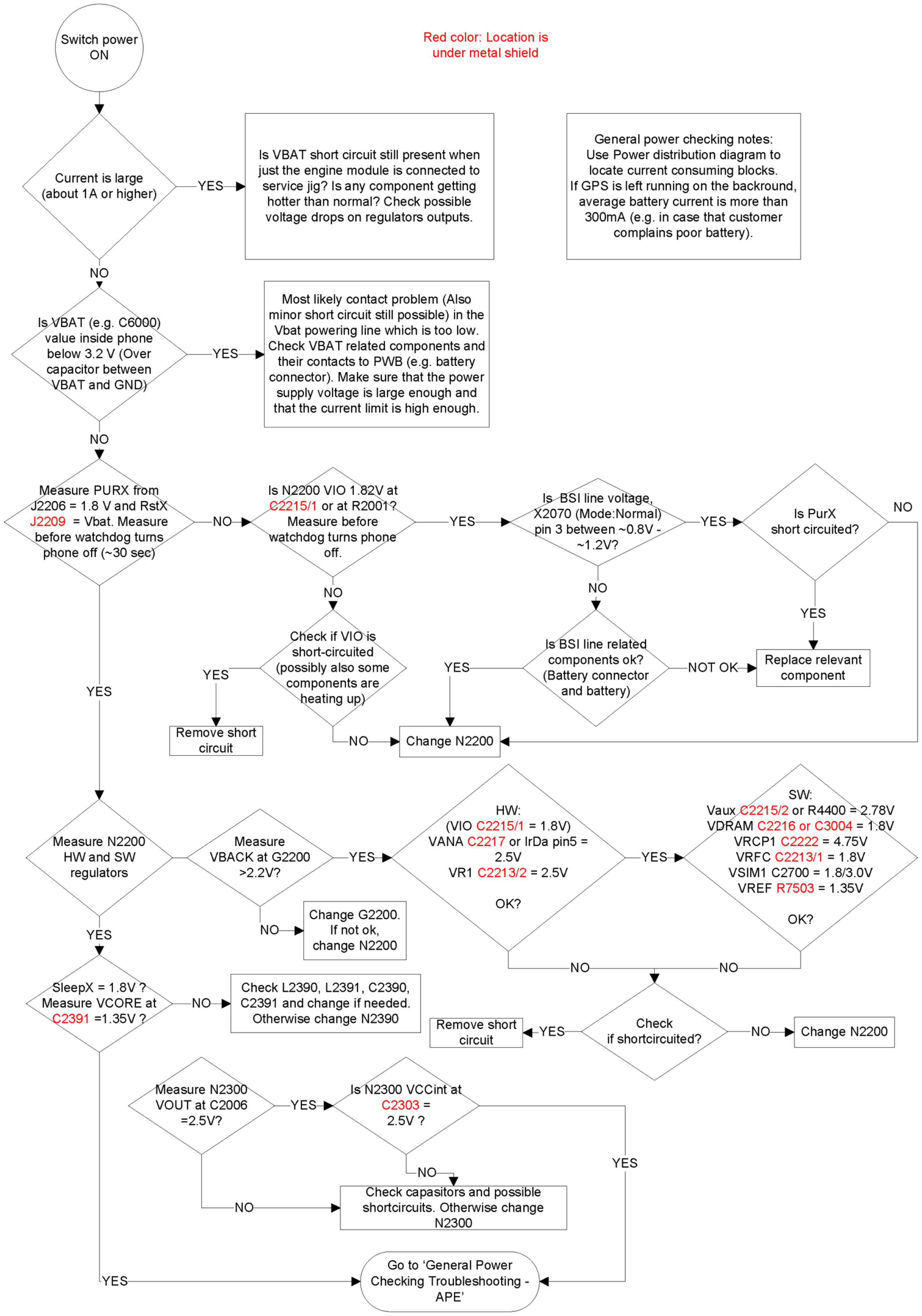
APE temperature sensor troubleshooting

Troubleshooting flow


APE Temperature Sensor Troubleshooting
Run ST_TEMP_SENSOR_IF_TEST self-test with Phoenix. Test passed?
Yes
End
No
Measure VAUX_APE voltage at C4810. ~2.8V?
Yes
Change temperature sensor N4801
Run ST_TEMP_SENSOR_IF_TEST self-test with Phoenix. Test passed?
Yes
Note that VAUX_APE will not be on all the time. It will wake up for 500ms once in 30s.
No
Check for short circuit at C4810 to ground. Short circuit found?
Yes
Check C4810, L4800 & C4211. See if some component is heating up. Change that component. If only N4200 is heating, change N4801
Run ST_TEMP_SENSOR_IF_TEST self-test with Phoenix. Test passed?
Yes
End
No
Check PWB resistance between C4211 and C4810. Resistance >100ohms?
Yes
Check L4800. Resistance >100ohms?
No
PWB broken. Beyond economical repair
Yes
No
No
Change L4800
Yes
No
Run ST_MENELAUS_IF_TEST self-test with Phoenix. Test passed?
No
Change N4200
Yes
Change N4200
Run ST_MENELAUS_IF_TEST self-test with Phoenix. Test passed?
No
D4800 broken. Beyond economical repair
Yes
Measure VAUX_APE voltage at C4810. ~2.8V?
Yes
Run ST_TEMP_SENSOR_IF_TEST self-test with Phoenix. Test passed?
Yes
End
Yes
No
No
Change temperature sensor N4801
Run ST_TEMP_SENSOR_IF_TEST self-test with Phoenix. Test passed?
PWB broken. Beyond economical repair
No

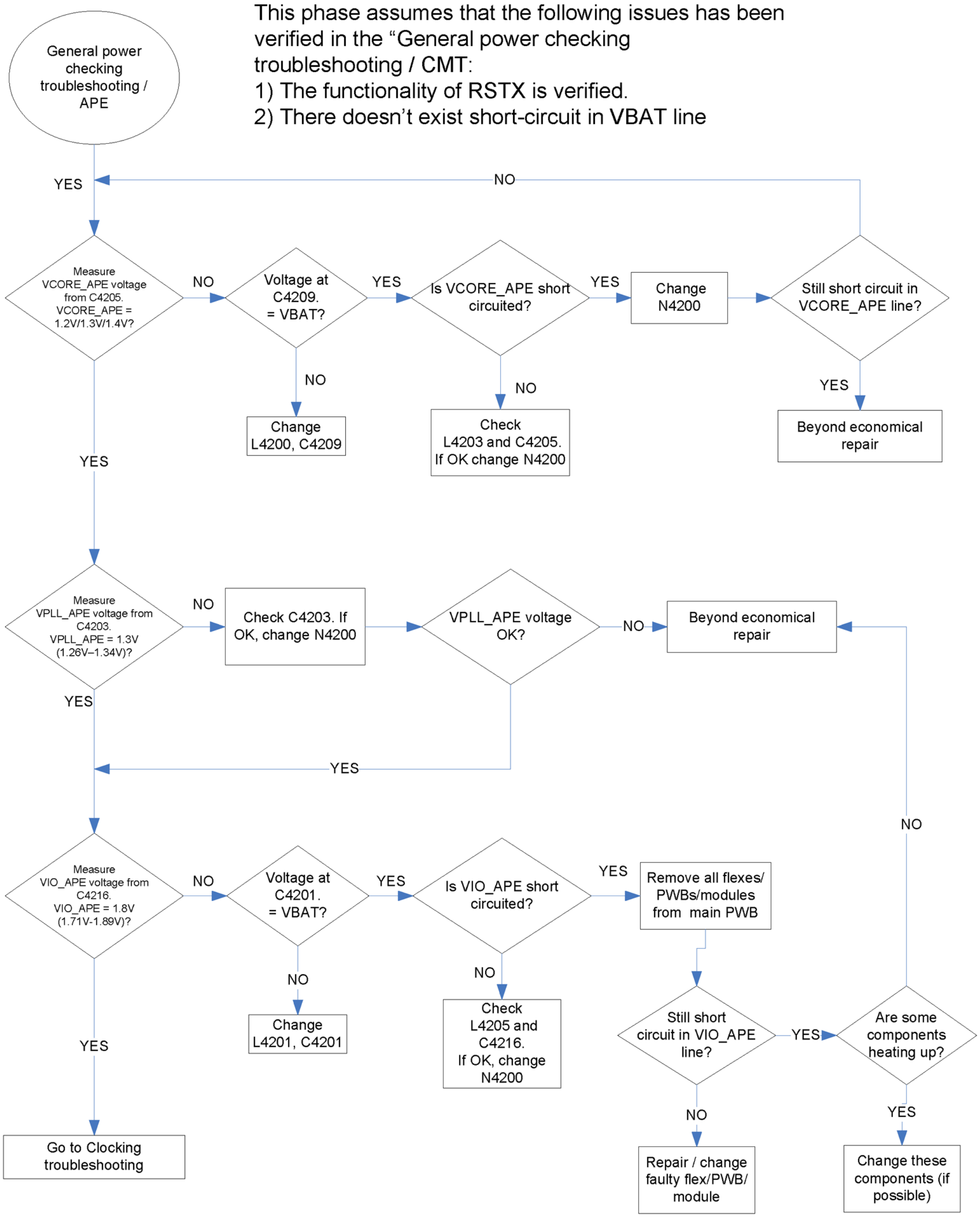
General power checking troubleshooting - CMT

Troubleshooting flow


Red color: Location is under metal shield
Switch power ON
Current is large (about 1A or higher)
YES
Is VBAT short circuit still present when just the engine module is connected to service jig? Is any component getting hotter than normal? Check possible voltage drops on regulators outputs.
General power checking notes: Use Power distribution diagram to locate current consuming blocks. If GPS is left running on the backround, average battery current is more than 300mA (e.g. in case that customer complains poor battery).
NO
Is VBAT (e.g. C6000) value inside phone below 3.2 V (Over capacitor between VBAT and GND)
YES
Most likely contact problem (Also minor short circuit still possible) in the Vbat powering line which is too low. Check VBAT related components and their contacts to PWB (e.g. battery connector). Make sure that the power supply voltage is large enough and that the current limit is high enough.
NO
Measure PURX from J2206 = 1.8 V and RstX J2209 = Vbat. Measure before watchdog turns phone off (~30 sec)
NO
Is N2200 VIO 1.82V at C2215/1 or at R2001? Measure before watchdog turns phone off.
YES
Is BSI line voltage, X2070 (Mode:Normal) pin 3 between ~0.8V - ~1.2V?
YES
Is PurX short circuited?
NO
YES
Replace relevant component
NO
Is BSI line related components ok? (Battery connector and battery)
NOT OK
YES
NO
Check if VIO is short-circuited (possibly also some components are heating up)
YES
Remove short circuit
NO
Change N2200
YES
Measure N2200 HW and SW regulators
Measure VBACK at G2200 >2.2V?
YES
NO
Change G2200. If not ok, change N2200
HW: (VIO C2215/1 = 1.8V) VANA C2217 or IrDa pin5 = 2.5V VR1 C2213/2 = 2.5V OK?
YES
SW: Vaux C2215/2 or R4400 = 2.78V VDRAM C2216 or C3004 = 1.8V VRCP1 C2222 = 4.75V VRFC C2213/1 = 1.8V VSIM1 C2700 = 1.8/3.0V VREF R7503 = 1.35V OK?
NO
NO
Check if shortcircuited?
YES
Remove short circuit
NO
Change N2200
YES
SleepX = 1.8V ? Measure VCORE at C2391 =1.35V ?
NO
Check L2390, L2391, C2390, C2391 and change if needed. Otherwise change N2390
Measure N2300 VOUT at C2006 =2.5V?
YES
Is N2300 VCCint at C2303 = 2.5V ?
NO
Check capasitors and possible shortcircuits. Otherwise change N2300
NO
YES
YES
Go to 'General Power Checking Troubleshooting - APE'

General power checking troubleshooting - APE

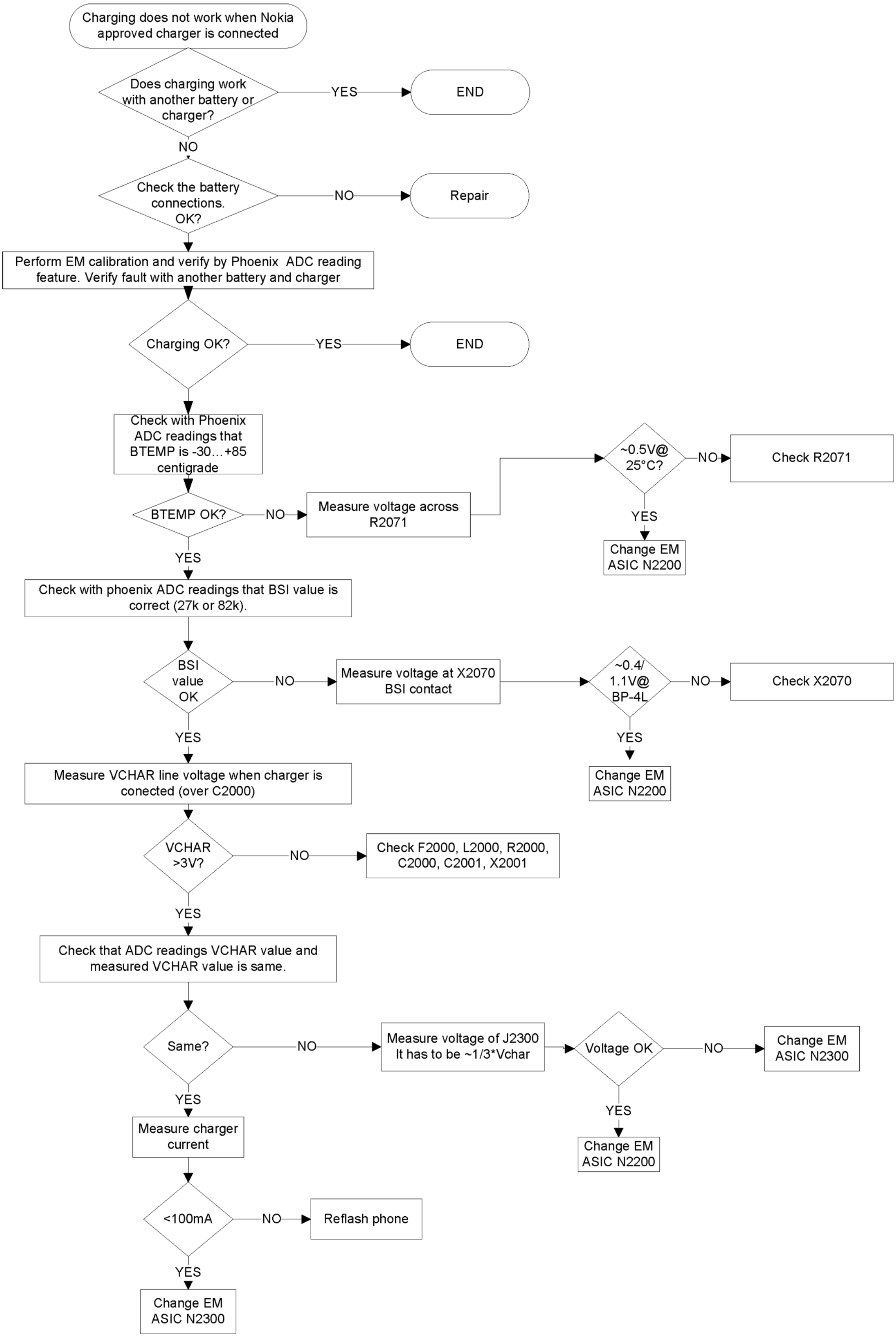
Troubleshooting flow


General power checking troubleshooting / APE
YES
NO
Measure VCORE_APE voltage from C4205. VCORE_APE = 1.2V/1.3V/1.4V?
NO
Voltage at C4209. = VBAT?
YES
Is VCORE_APE short circuited?
YES
Change N4200
Still short circuit in VCORE_APE line?
NO
Change L4200, C4209
NO
Check L4203 and C4205. If OK change N4200
YES
Beyond economical repair
YES
Measure VPLL_APE voltage from C4203. VPLL_APE = 1.3V (1.26V–1.34V)?
NO
Check C4203. If OK, change N4200
VPLL_APE voltage OK?
NO
Beyond economical repair
YES
YES
NO
Measure VIO_APE voltage from C4216. VIO_APE = 1.8V (1.71V-1.89V)?
NO
Voltage at C4201. = VBAT?
YES
Is VIO_APE short circuited?
YES
Remove all flexes/ PWBs/modules from main PWB
NO
Change L4201, C4201
NO
Check L4205 and C4216. If OK, change N4200
Still short circuit in VIO_APE line?
YES
Are some components heating up?
YES
Go to Clocking troubleshooting
NO
Repair / change faulty flex/PWB/ module
YES
Change these components (if possible)

This phase assumes that the following issues has been verified in the “General power checking troubleshooting / CMT:
1) The functionality of RSTX is verified.
2) There doesn’t exist short-circuit in VBAT line

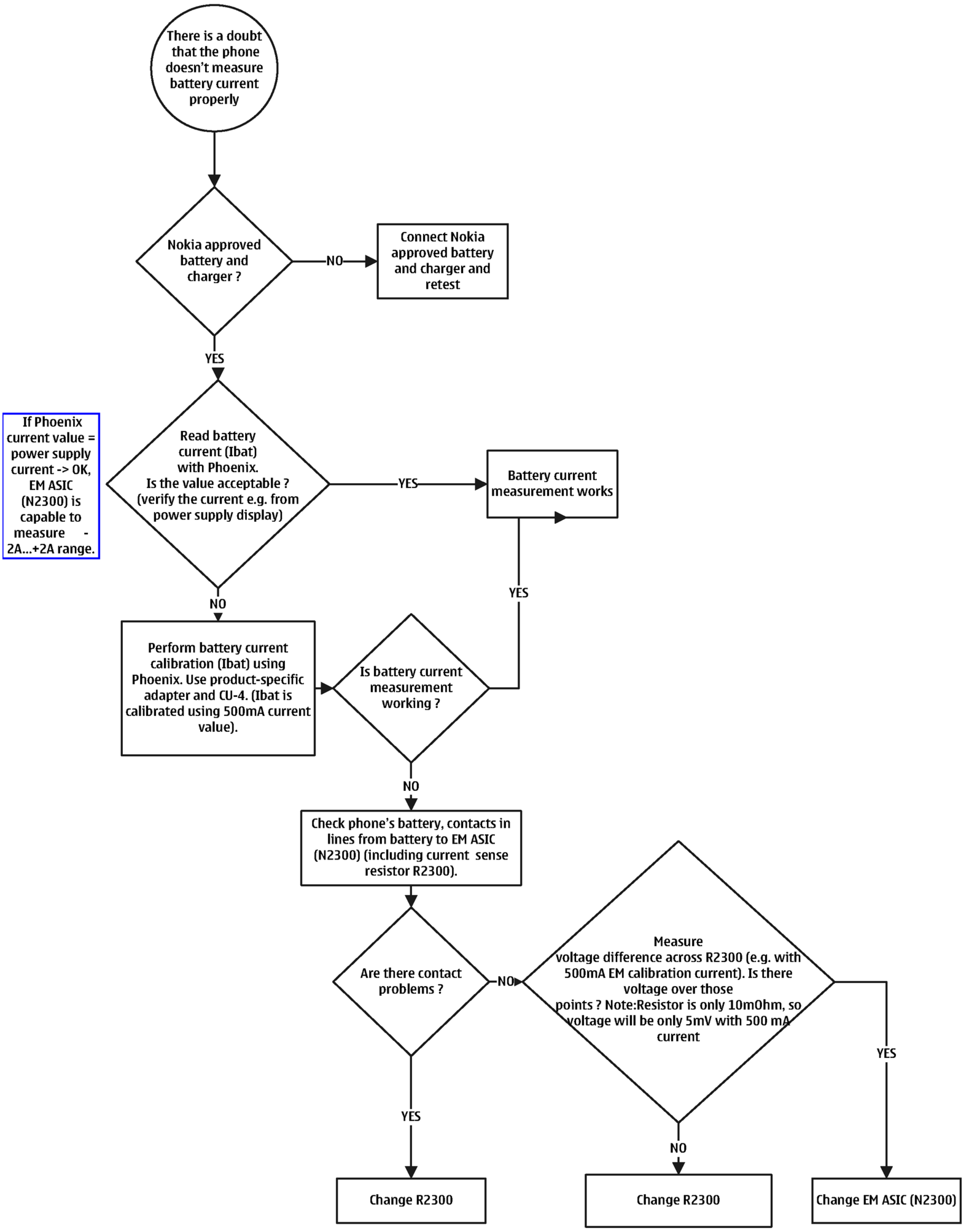
Charging troubleshooting

Troubleshooting flow


Charging does not work when Nokia approved charger is connected
Does charging work with another battery or charger?
YES
END
NO
Check the battery connections. OK?
NO
Repair
Perform EM calibration and verify by Phoenix ADC reading feature. Verify fault with another battery and charger
Charging OK?
YES
END
Check with Phoenix ADC readings that BTEMP is -30…+85 centigrade
BTEMP OK?
NO
Measure voltage across R2071
~0.5V@ 25°C?
NO
Check R2071
YES
Change EM ASIC N2200
YES
Check with phoenix ADC readings that BSI value is correct (27k or 82k).
BSI value OK
NO
Measure voltage at X2070 BSI contact
~0.4/ 1.1V@ BP-4L
NO
Check X2070
YES
Change EM ASIC N2200
YES
Measure VCHAR line voltage when charger is conected (over C2000)
VCHAR >3V?
NO
Check F2000, L2000, R2000, C2000, C2001, X2001
YES
Check that ADC readings VCHAR value and measured VCHAR value is same.
Same?
NO
Measure voltage of J2300 It has to be ~1/3*Vchar
Voltage OK
NO
Change EM ASIC N2300
YES
Change EM ASIC N2200
YES
Measure charger current
<100mA
NO
Reflash phone
YES
Change EM ASIC N2300

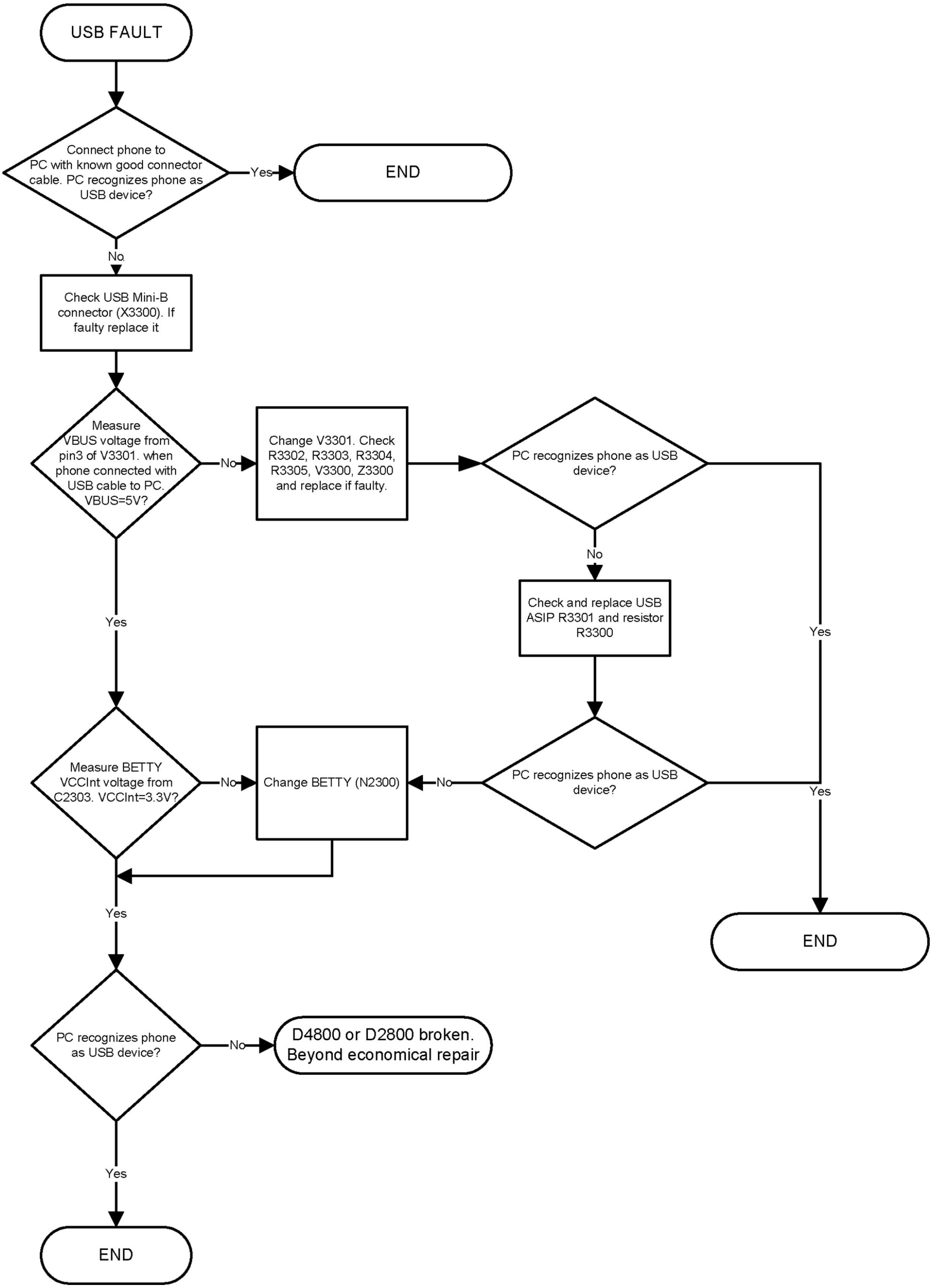
Current measuring troubleshooting

Troubleshooting flow


There is a doubt that the phone doesn't measure battery current properly
Nokia approved battery and charger ?
NO
Connect Nokia approved battery and charger and retest
YES
If Phoenix current value = power supply current -> OK, EM ASIC (N2300) is capable to measure -2A...+2A range.
Read battery current (Ibat) with Phoenix. Is the value acceptable ? (verify the current e.g. from power supply display)
YES
Battery current measurement works
NO
Perform battery current calibration (Ibat) using Phoenix. Use product-specific adapter and CU-4. (Ibat is calibrated using 500mA current value).
Is battery current measurement working ?
YES
NO
Check phone's battery, contacts in lines from battery to EM ASIC (N2300) (including current sense resistor R2300).
Are there contact problems ?
NO
Measure voltage difference across R2300 (e.g. with 500mA EM calibration current). Is there voltage over those points ? Note:Resistor is only 10mOhm, so voltage will be only 5mV with 500 mA current
YES
YES
NO
Change R2300
Change R2300
Change EM ASIC (N2300)

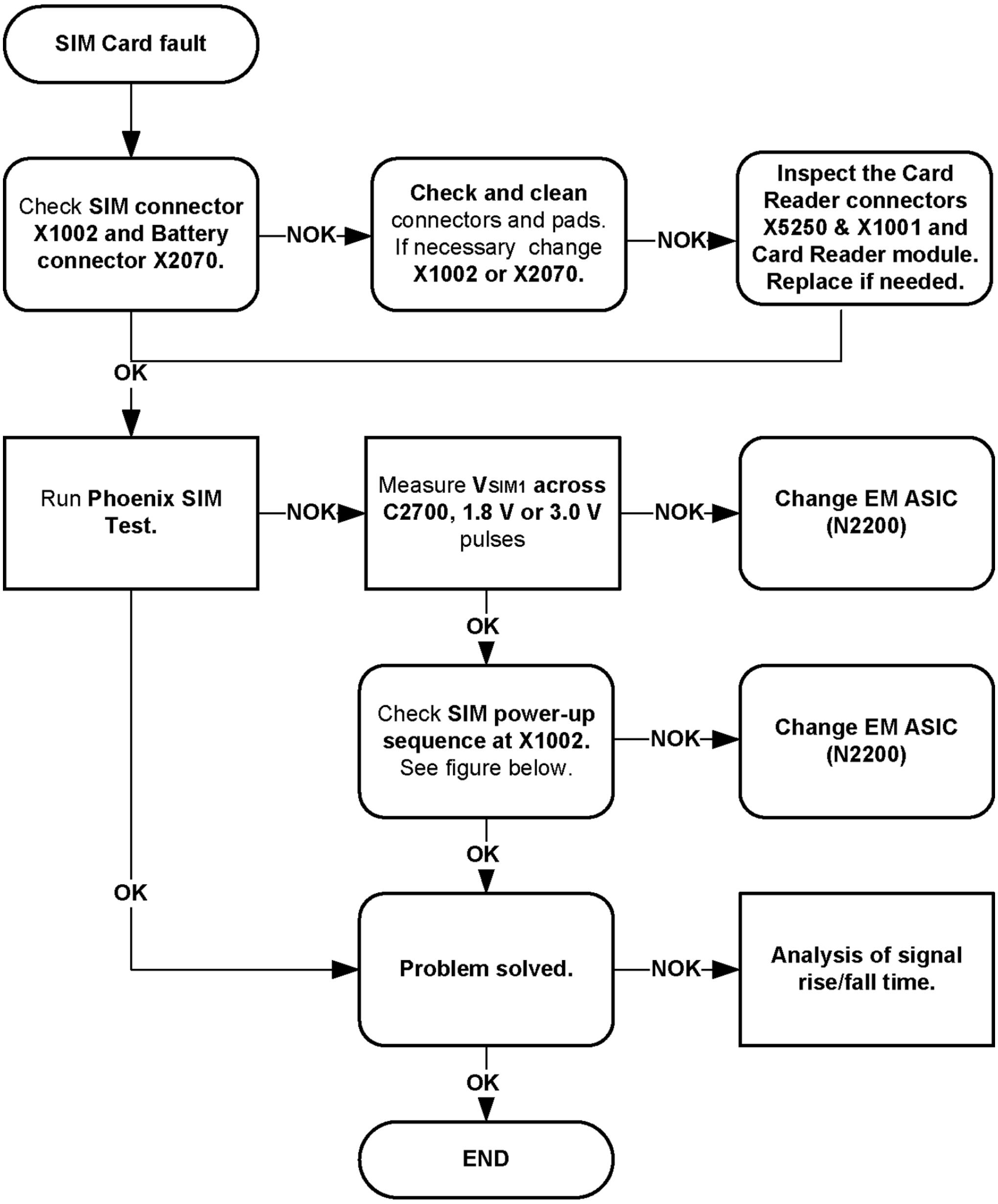
USB troubleshooting

Troubleshooting flow

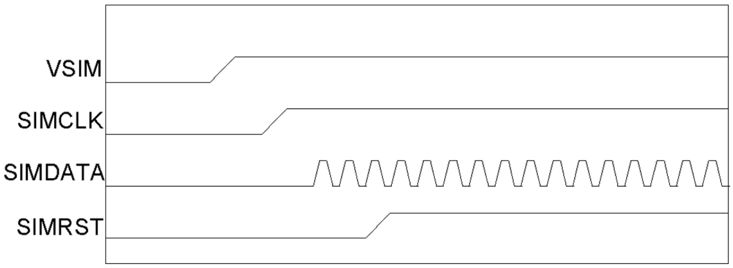

USB FAULT
Connect phone to PC with known good connector cable. PC recognizes phone as USB device?
Yes
END
No
Check USB Mini-B connector (X3300). If faulty replace it
Measure VBUS voltage from pin3 of V3301. when phone connected with USB cable to PC. VBUS=5V?
No
Change V3301. Check R3302, R3303, R3304, R3305, V3300, Z3300 and replace if faulty.
PC recognizes phone as USB device?
No
Check and replace USB ASIP R3301 and resistor R3300
Yes
Yes
PC recognizes phone as USB device?
No
Yes
Change BETTY (N2300)
Measure BETTY VCCInt voltage from C2303. VCCInt=3.3V?
No
END
Yes
PC recognizes phone as USB device?
No
D4800 or D2800 broken. Beyond economical repair
Yes
END

SIM card troubleshooting

Troubleshooting flow

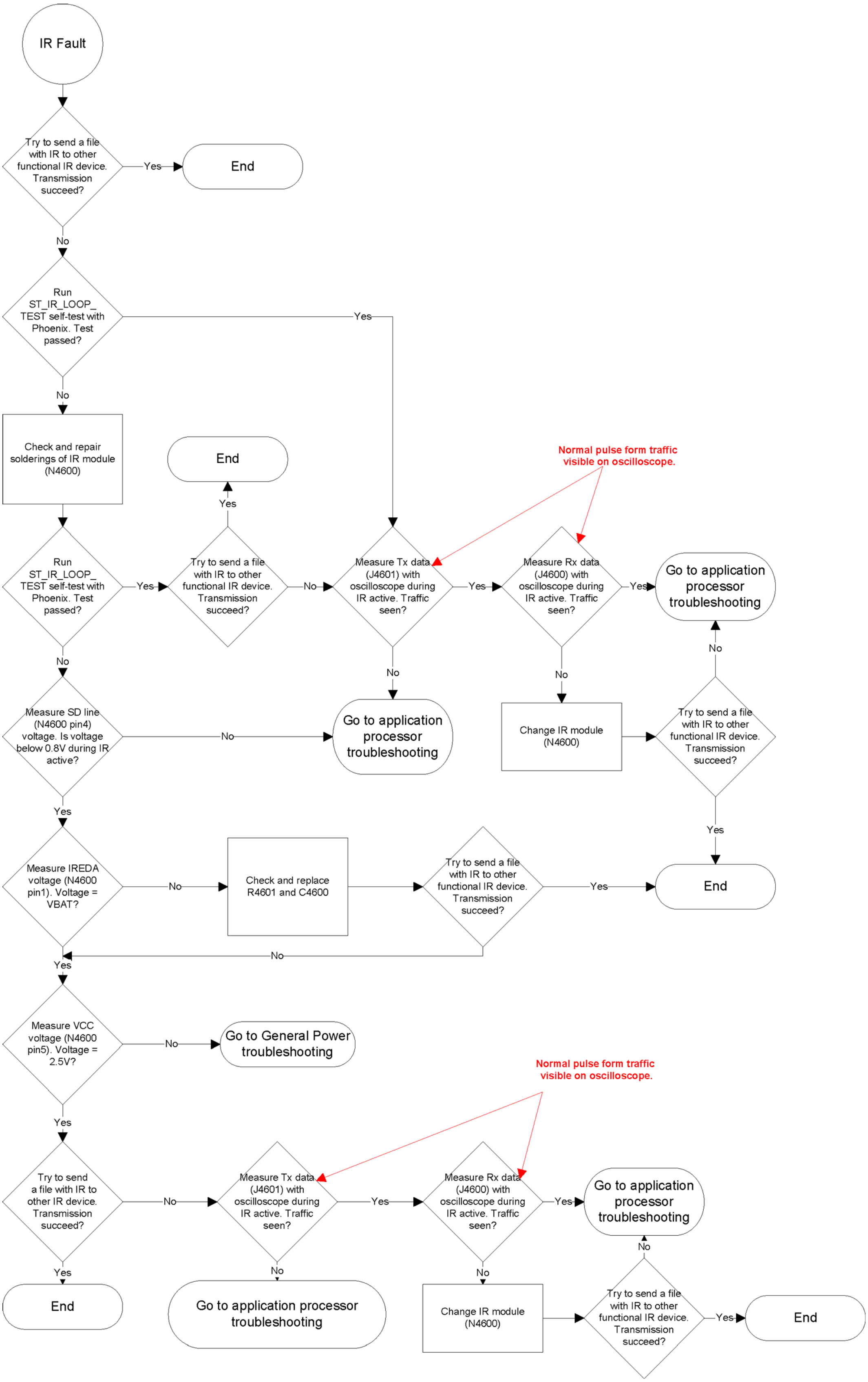

SIM Card fault
Check SIM connector X1002 and Battery connector X2070.
NOK
Check and clean connectors and pads. If necessary change X1002 or X2070.
NOK
Inspect the Card Reader connectors X5250 & X1001 and Card Reader module. Replace if needed.
OK
Run Phoenix SIM Test.
NOK
Measure VSIM1 across C2700, 1.8 V or 3.0 V pulses
NOK
Change EM ASIC (N2200)
OK
Check SIM power-up sequence at X1002. See figure below.
NOK
Change EM ASIC (N2200)
OK
OK
Problem solved.
NOK
Analysis of signal rise/fall time.
OK
END

SIM power-up sequence


VSIM
SIMCLK
SIMDATA
SIMRST

IrDA troubleshooting

Troubleshooting flow


IR Fault
Try to send a file with IR to other functional IR device. Transmission succeed?
Yes
End
No
Run ST_IR_LOOP_TEST self-test with Phoenix. Test passed?
Yes
No
Check and repair solderings of IR module (N4600)
End
Yes
Normal pulse form traffic visible on oscilloscope.
Run ST_IR_LOOP_TEST self-test with Phoenix. Test passed?
Yes
Try to send a file with IR to other functional IR device. Transmission succeed?
No
Measure Tx data (J4601) with oscilloscope during IR active. Traffic seen?
Yes
Measure Rx data (J4600) with oscilloscope during IR active. Traffic seen?
Yes
Go to application processor troubleshooting
No
No
No
No
Measure SD line (N4600 pin4) voltage. Is voltage below 0.8V during IR active?
No
Go to application processor troubleshooting
Change IR module (N4600)
Try to send a file with IR to other functional IR device. Transmission succeed?
Yes
Yes
Measure IREDA voltage (N4600 pin1). Voltage = VBAT?
No
Check and replace R4601 and C4600
Try to send a file with IR to other functional IR device. Transmission succeed?
Yes
End
No
Yes
Measure VCC voltage (N4600 pin5). Voltage = 2.5V?
No
Go to General Power troubleshooting
Normal pulse form traffic visible on oscilloscope.
Yes
Try to send a file with IR to other IR device. Transmission succeed?
No
Measure Tx data (J4601) with oscilloscope during IR active. Traffic seen?
Yes
Measure Rx data (J4600) with oscilloscope during IR active. Traffic seen?
Yes
Go to application processor troubleshooting
No
Yes
No
No
End
Go to application processor troubleshooting
Change IR module (N4600)
Try to send a file with IR to other functional IR device. Transmission succeed?
Yes
End

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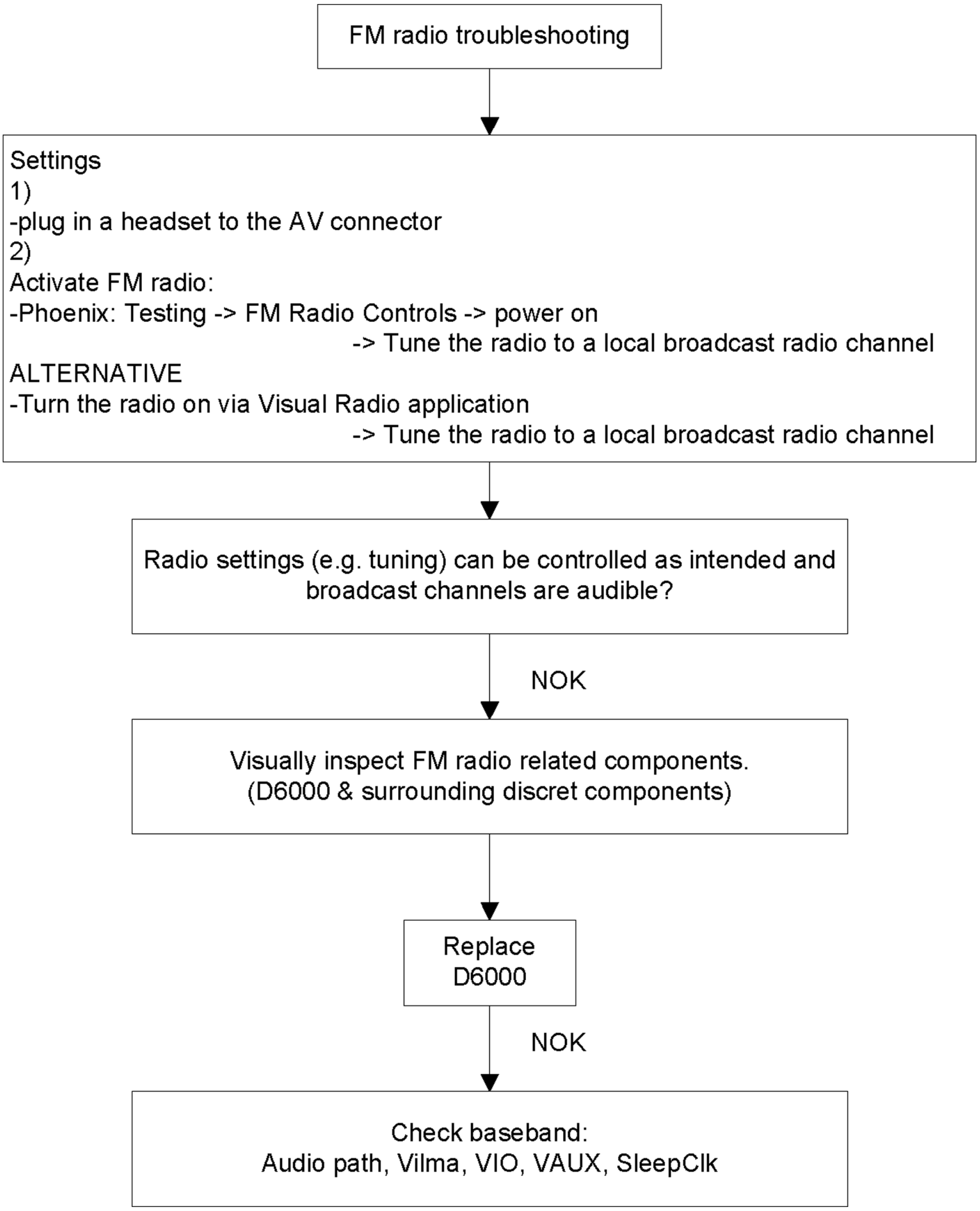
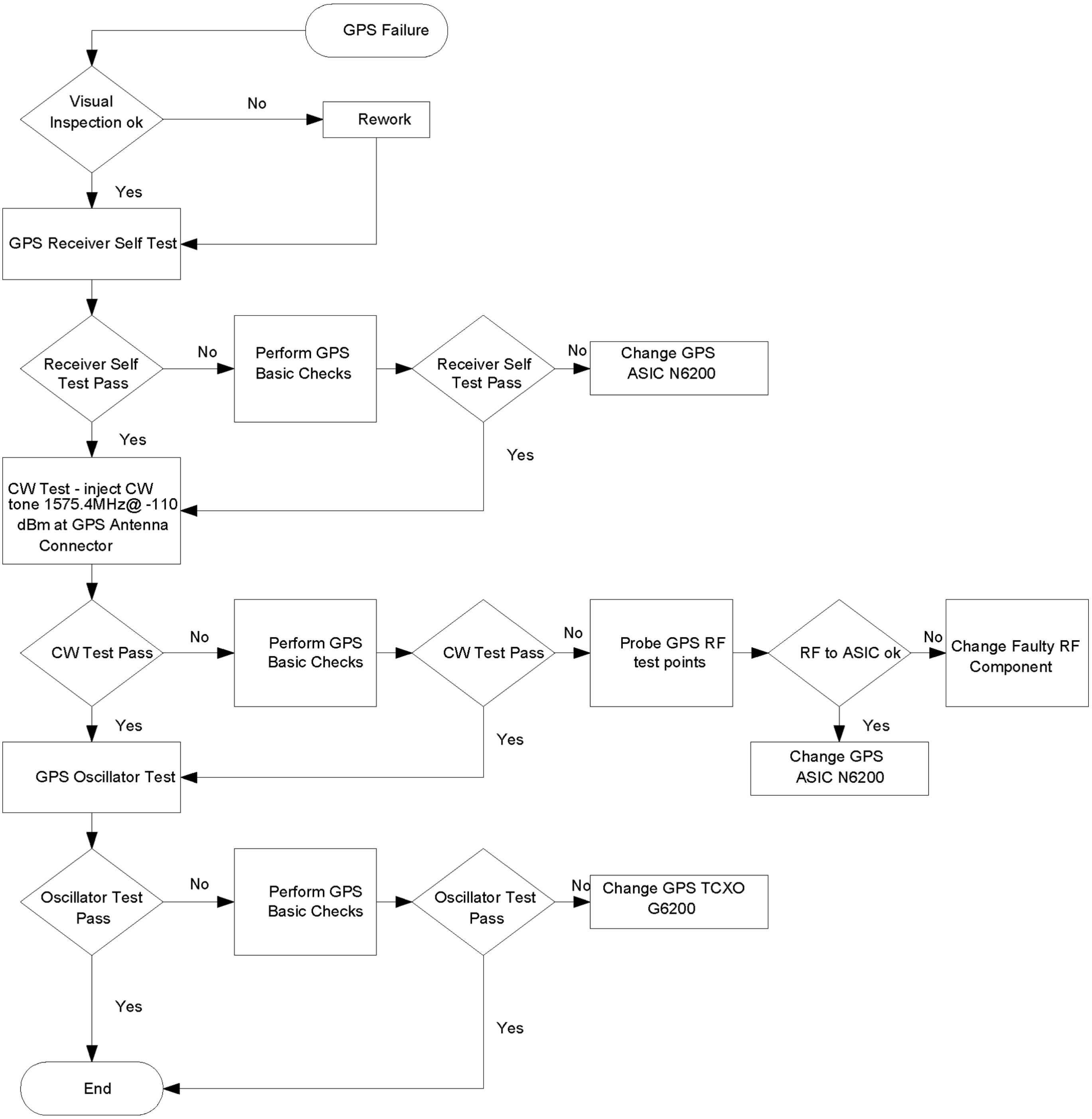
FM radio troubleshooting

Troubleshooting flow


FM radio troubleshooting
Settings
1)
-plug in a headset to the AV connector
2)
Activate FM radio:
-Phoenix: Testing -> FM Radio Controls -> power on
-> Tune the radio to a local broadcast radio channel
ALTERNATIVE
-Turn the radio on via Visual Radio application
-> Tune the radio to a local broadcast radio channel
Radio settings (e.g. tuning) can be controlled as intended and broadcast channels are audible?
NOK
Visually inspect FM radio related components.
(D6000 & surrounding discret components)
Replace D6000
NOK
Check baseband:
Audio path, Vilma, VIO, VAUX, SleepClk

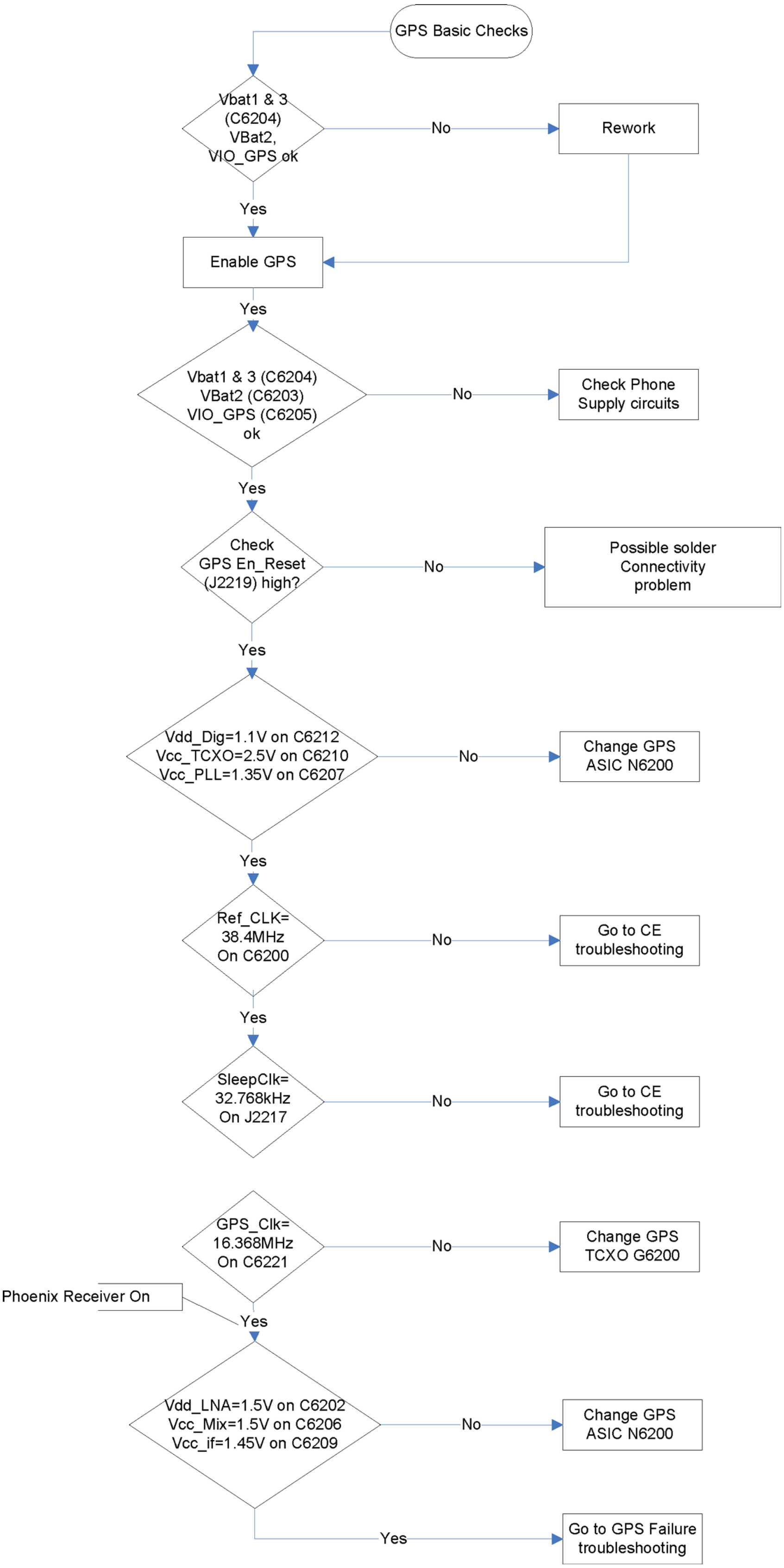
GPS failure troubleshooting

Troubleshooting flow


GPS Failure
Visual Inspection ok
No
Rework
Yes
GPS Receiver Self Test
Receiver Self Test Pass
No
Perform GPS Basic Checks
Receiver Self Test Pass
No
Change GPS ASIC N6200
Yes
Yes
CW Test - inject CW tone 1575.4MHz@ -110 dBm at GPS Antenna Connector
CW Test Pass
No
Perform GPS Basic Checks
CW Test Pass
No
Probe GPS RF test points
RF to ASIC ok
No
Change Faulty RF Component
Yes
Yes
Yes
GPS Oscillator Test
Change GPS ASIC N6200
Oscillator Test Pass
No
Perform GPS Basic Checks
Oscillator Test Pass
No
Change GPS TCXO G6200
Yes
Yes
End

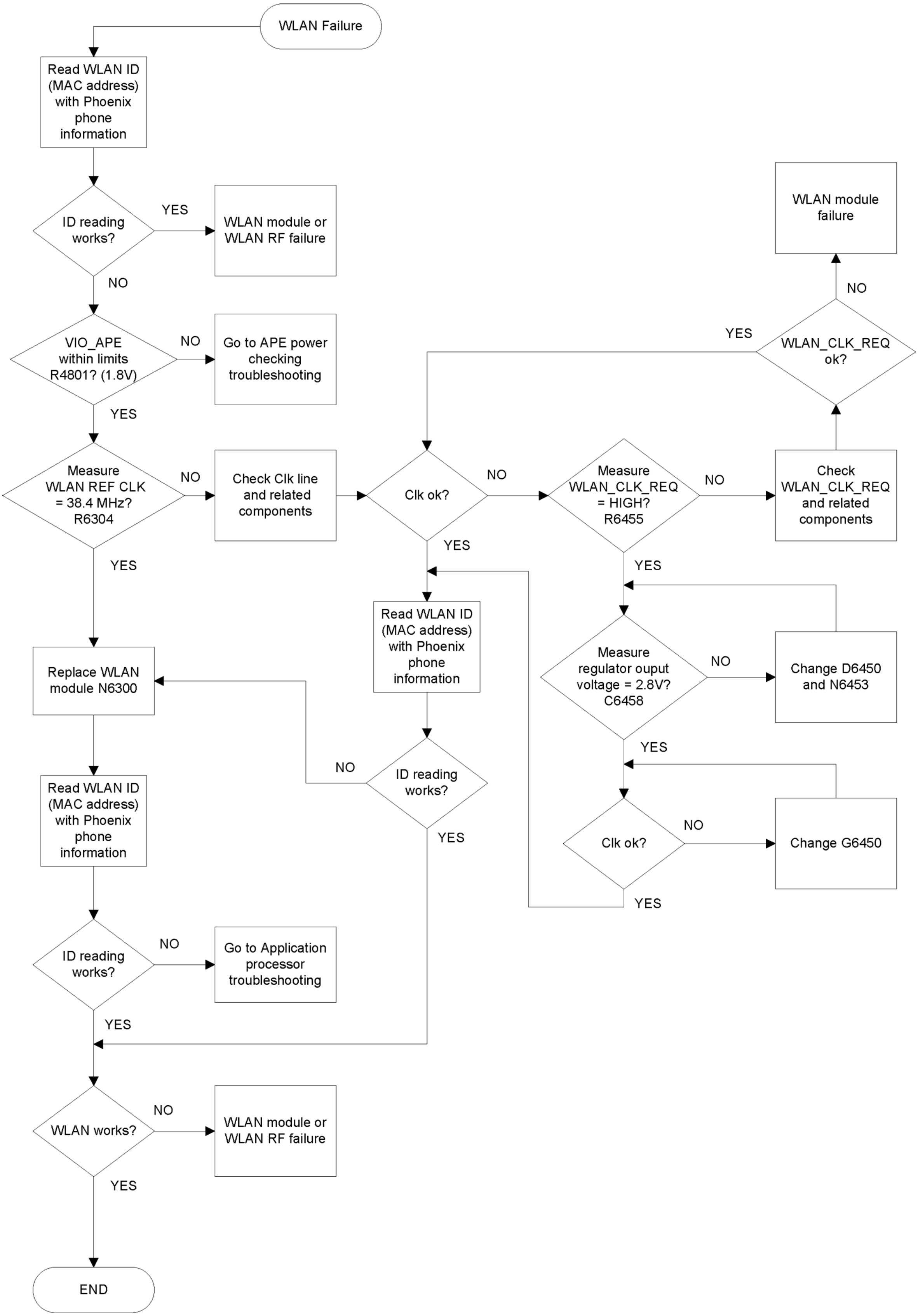
GPS basic checks troubleshooting

Troubleshooting flow


GPS Basic Checks
Vbat1 & 3 (C6204) VBat2, VIO_GPS ok
No
Rework
Yes
Enable GPS
Yes
Vbat1 & 3 (C6204) VBat2 (C6203) VIO_GPS (C6205) ok
No
Check Phone Supply circuits
Yes
Check GPS En_Reset (J2219) high?
No
Possible solder Connectivity problem
Yes
Vdd_Dig=1.1V on C6212 Vcc_TCXO=2.5V on C6210 Vcc_PLL=1.35V on C6207
No
Change GPS ASIC N6200
Yes
Ref_CLK= 38.4MHz On C6200
No
Go to CE troubleshooting
Yes
SleepClk= 32.768kHz On J2217
No
Go to CE troubleshooting
GPS_Clk= 16.368MHz On C6221
No
Change GPS TCXO G6200
Phoenix Receiver On
Yes
Vdd_LNA=1.5V on C6202 Vcc_Mix=1.5V on C6206 Vcc_if=1.45V on C6209
No
Change GPS ASIC N6200
Yes
Go to GPS Failure troubleshooting

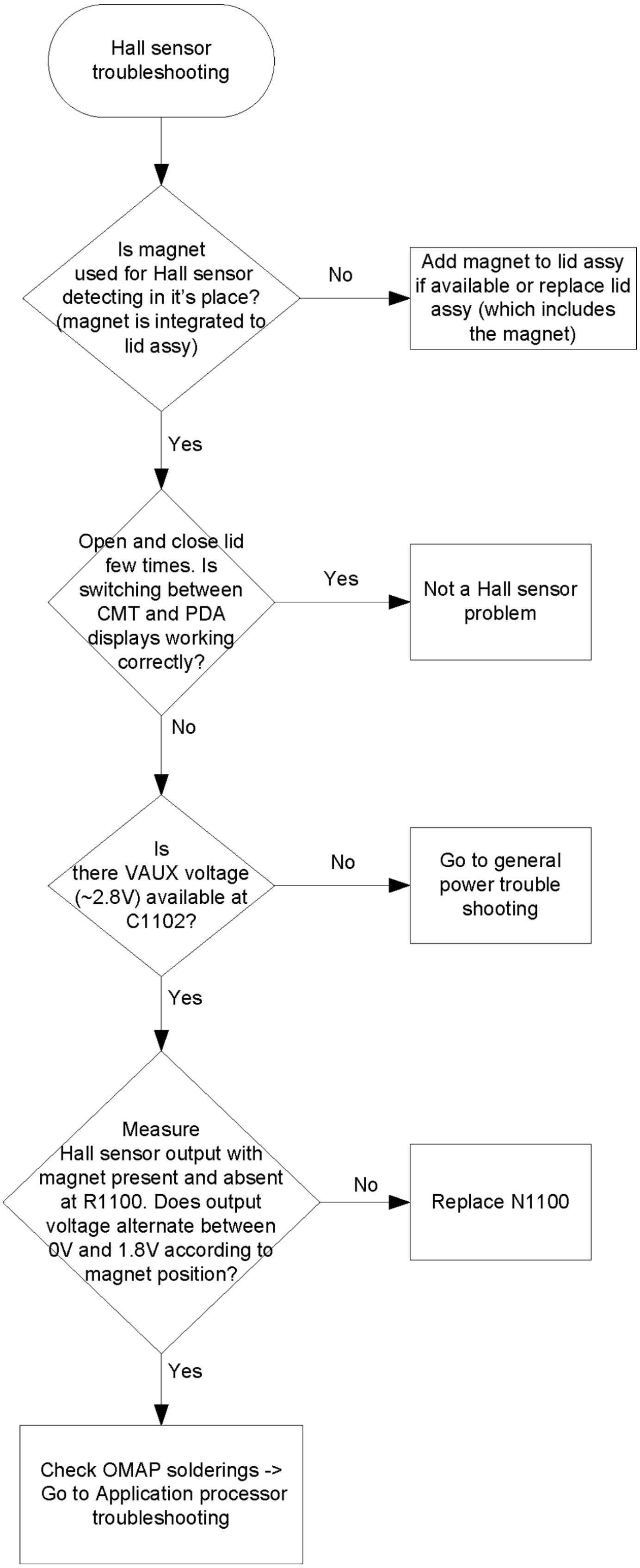
WLAN troubleshooting

Troubleshooting flow


WLAN Failure
Read WLAN ID (MAC address) with Phoenix phone information
ID reading works?
YES
WLAN module or WLAN RF failure
NO
VIO_APE within limits R4801? (1.8V)
NO
Go to APE power checking troubleshooting
YES
Measure WLAN REF CLK = 38.4 MHz? R6304
NO
Check Clk line and related components
Clk ok?
NO
Measure WLAN_CLK_REQ = HIGH? R6455
NO
Check WLAN_CLK_REQ and related components
WLAN_CLK_REQ ok?
NO
WLAN module failure
YES
YES
Read WLAN ID (MAC address) with Phoenix phone information
ID reading works?
NO
YES
YES
Measure regulator ouput voltage = 2.8V? C6458
NO
Change D6450 and N6453
YES
Clk ok?
NO
Change G6450
YES
YES
Replace WLAN module N6300
Read WLAN ID (MAC address) with Phoenix phone information
ID reading works?
NO
Go to Application processor troubleshooting
YES
WLAN works?
NO
WLAN module or WLAN RF failure
YES
END

Hall sensor troubleshooting

Troubleshooting flow


Hall sensor troubleshooting
Is magnet used for Hall sensor detecting in it's place? (magnet is integrated to lid assy)
No
Add magnet to lid assy if available or replace lid assy (which includes the magnet)
Yes
Open and close lid few times. Is switching between CMT and PDA displays working correctly?
Yes
Not a Hall sensor problem
No
Is there VAUX voltage (~2.8V) available at C1102?
No
Go to general power trouble shooting
Yes
Measure Hall sensor output with magnet present and absent at R1100. Does output voltage alternate between 0V and 1.8V according to magnet position?
No
Replace N1100
Yes
Check OMAP solderings -> Go to Application processor troubleshooting

Certificate restoring for BB5 products

Context

This procedure is performed when the device certificate is corrupted for some reason.

All tunings (RF & Baseband, UI) must be done after performing the certificate restoring procedure.

The procedure for certificate restoring is the following:

- Flash the phone with the latest available software using FPS-8 or FPS-10.

  Note: USB flashing does not work for a dead BB5 phone.
- Create a request file.
- Send the file to Nokia by e-mail. Use the following addresses depending on your location:
  - APAC: sydney.service@nokia.com
  - CHINA: repair.ams@nokia.com
  - E&A: salo.repair@nokia.com
  - AMERICAS: fls1.usa@nokia.com
- When you receive a reply from Nokia, carry out certificate restoring.
- Tune the phone completely.

  Note: SX-4 smart card is needed.
- If the phone resets after certificate restoring, reflash the phone again.

Required equipment and setup:

- *Phoenix* service software v 2004.39.7.70 or newer.
- The latest phone model specific *Phoenix* data package.
- PKD-1 dongle
- SX-4 smart card (Enables BB5 testing and tuning features)
- External smart card reader

  Note: The smart card reader is only needed when FPS-8 is used. FPS-10 has an integrated smart card reader.
- Activated FPS-8 flash prommer **OR** FPS-10 flash prommer
- Flash update package 03.18.004 or newer for FPS-8 or FPS-10 flash prommers
- CU-4 control unit
- USB cable from PC USB Port to CU-4 control unit
- Phone model specific adapter for CU-4 control unit
- PCS-1 cable to power CU-4 from external power supply
- XCS-4 modular cable between flash prommer and CU-4

  Note: CU-4 must be supplied with +12 V from an external power supply in all steps of certificate restoring.

Steps

1. Program the phone software.

   i Start *Phoenix* and login. Make sure the connection has been managed correctly for FPS-8 or FPS-10.

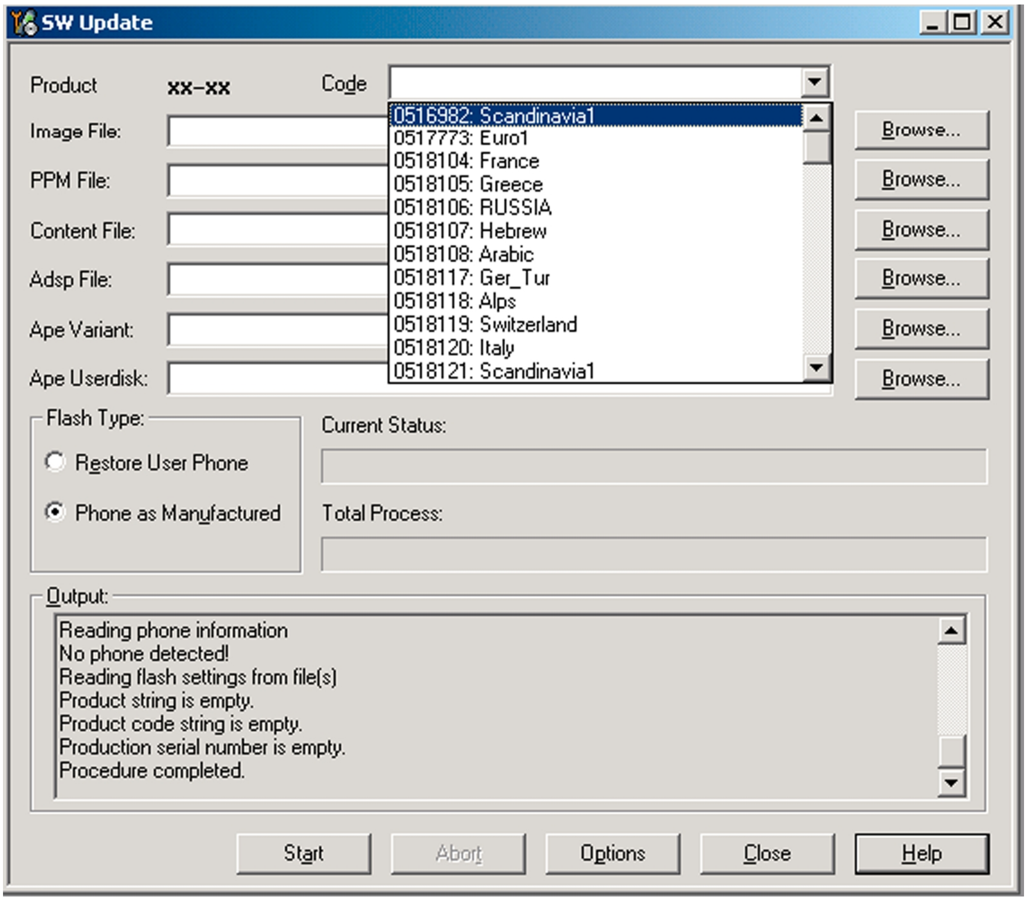
   ii Update the phone MCU software to the latest available version.

   If the new flash is empty and the phone cannot communicate with *Phoenix*, reflash the phone.

iii Choose the product manually from **File→Open Product** , and click **OK**.

Wait for the phone type designator (e.g. “RM-1”) to be displayed in the status bar.

iv Go to **Flashing→SW Update** and wait until *Phoenix* reads the product data as shown in the following picture.


SW Update
Code
Image File:
PPM File:
Content File:
Adsp File:
Ape Variant:
Ape Userdisk:
0516982: Scandinavia1
0517773: Euro1
0518104: France
0518105: Greece
0518106: RUSSIA
0518107: Hebrew
0518108: Arabic
0518117: Ger_Tur
0518118: Alps
0518119: Switzerland
0518120: Italy
0518121: Scandinavia1
Browse...
Browse...
Browse...
Browse...
Browse...
Browse...
Current Status:
Total Process:
Output:
Start
Abort
Options
Close
Help

Product xx-xx

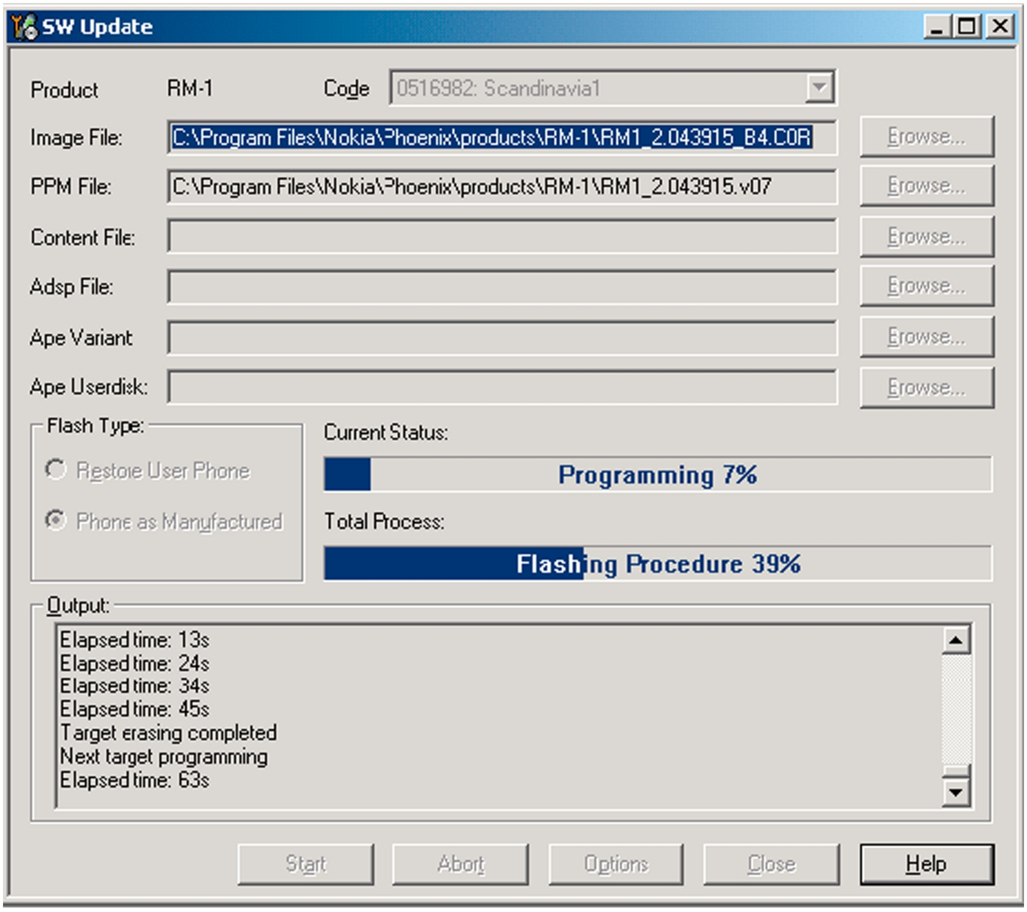
Flash Type:
○ Restore User Phone
● Phone as Manufactured

```
Reading phone information
No phone detected!
Reading flash settings from file(s)
Product string is empty.
Product code string is empty.
Production serial number is empty.
Procedure completed.
```

Product	is automatically set according to the phone support module which was opened manually, but the flash files cannot be found because the correct data cannot be read from the phone automatically.
Code	must be chosen manually, it determines the correct flash files to be used. Please choose the correct product code (can be seen in the phone type label) from the dropdown list.
Flash Type	must be set to **Phone as Manufactured**.

v To continue, click **Start**.

Progress bars and messages on the screen show actions during phone programming, please wait.


SW Update
Browse...
Browse...
Browse...
Browse...
Browse...
Browse...
Start
Abort
Options
Close
Help

Product: RM-1
Code: 0516982: Scandinavia1
Image File: C:\Program Files\Nokia\Phoenix\products\RM-1\RM1_2.043915_B4.C0R
PPM File: C:\Program Files\Nokia\Phoenix\products\RM-1\RM1_2.043915.v07
Content File:
Adsp File:
Ape Variant
Ape Userdisk:

Flash Type:
○ Restore User Phone
● Phone as Manufactured

Current Status: Programming 7%
Total Process: Flashing Procedure 39%

Output:

```
Elapsed time: 13s
Elapsed time: 24s
Elapsed time: 34s
Elapsed time: 45s
Target erasing completed
Next target programming
Elapsed time: 63s
```

Programming is completed when *Flashing Completed* message is displayed.

The product type designator and MCU SW version are displayed in the status bar.

vi Close the *SW Update* window and then choose **File→Close Product** .

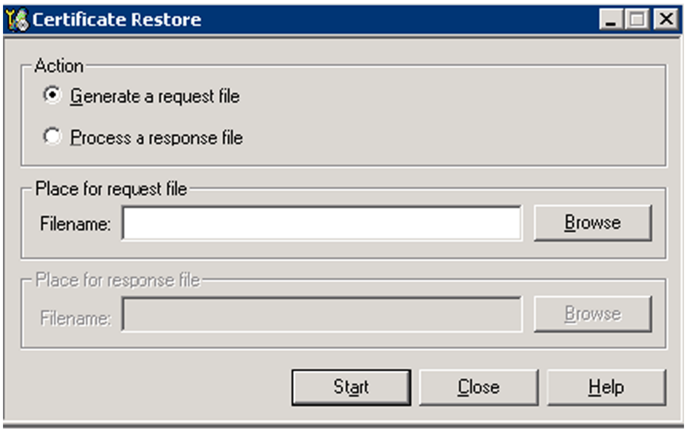
2. Create a *Request* file.

For this procedure, you must supply +12 V to CU-4 from an external power supply.

i To connect the phone with *Phoenix*, choose **File→Scan Product** .

ii Choose **Tools→Certificate Restore** .

iii To choose a location for the request file, click **Browse**.

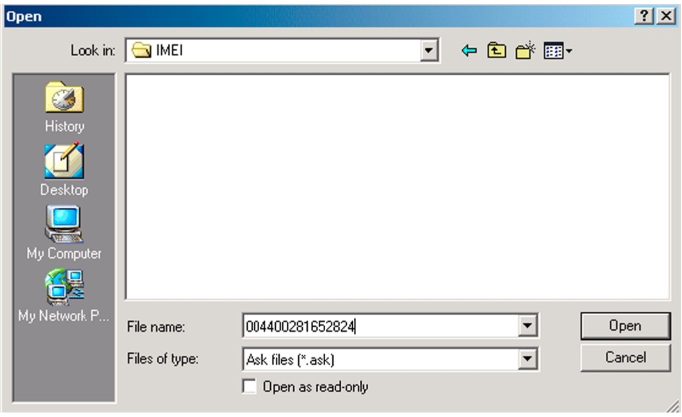

Certificate Restore
Browse
Browse
Start
Close
Help

Action
● Generate a request file
○ Process a response file

Place for request file
Filename:

Place for response file
Filename:

iv Name the file so that you can easily identify it, and click **Open**.


Open
History
Desktop
My Computer
My Network P...
Open
Cancel

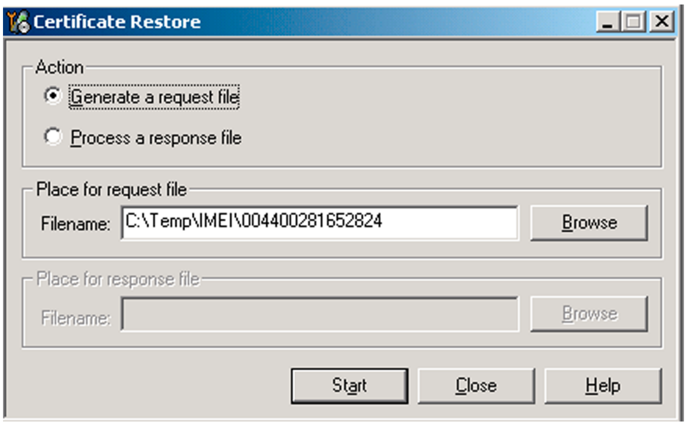
Look in: IMEI

File name: 004400281652824

Files of type: Ask files (*.ask)

☐ Open as read-only

The name of the file and its location are shown.


Certificate Restore
Action
Place for request file
Place for response file
Filename:
Browse
Browse
Start
Close
Help

● Generate a request file

○ Process a response file

Filename: C:\Temp\IMEI\004400281652824

v To create the *Request* file, click **Start**.

vi When the file for certificate restore has been created, send it to Nokia as an e-mail attachment.

3. Restore certificate.

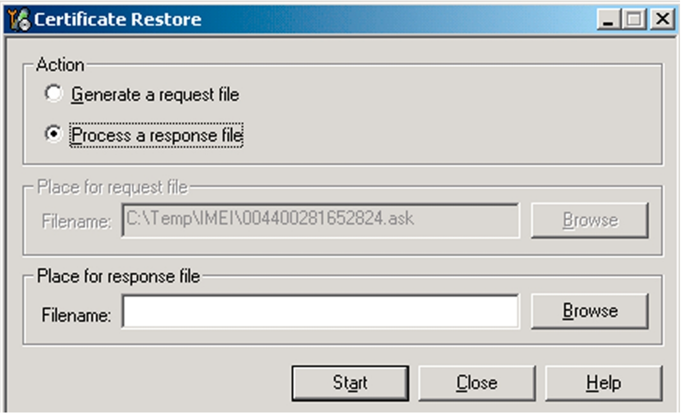
For this procedure, you must supply +12 V to CU-4 from an external power supply.

i Save the reply file sent by Nokia to your computer.

ii Start *Phoenix* service software.

iii Choose **File→Scan Product** .

iv From the **Tools** menu, choose **Certificate Restore** and select **Process a response file** in the *Action* pane.



Certificate Restore
Start
Close
Help
Browse
Browse

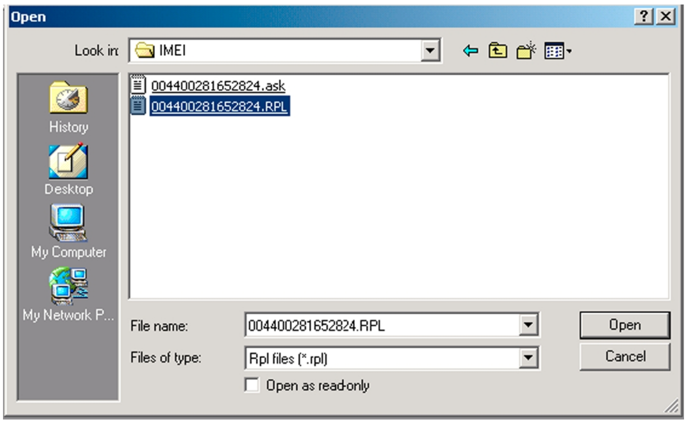
Action
○ Generate a request file
● Process a response file

Place for request file
Filename: C:\Temp\IMEI\004400281652824.ask

Place for response file
Filename:

v To choose the location where response file is saved, click **Browse**.

vi Click **Open**.



Open
History
Desktop
My Computer
My Network P...
Open
Cancel

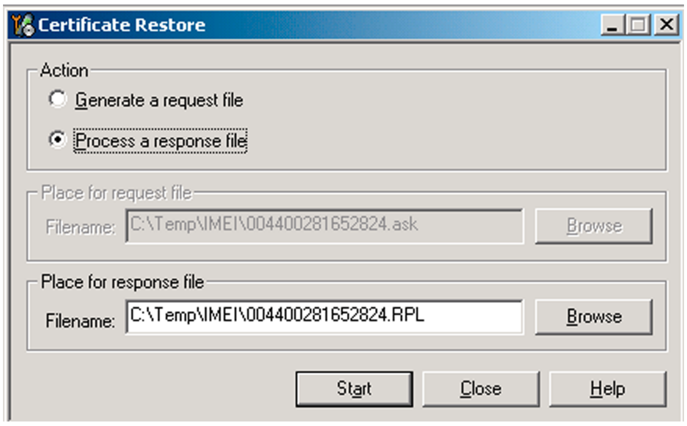
Look in: IMEI

004400281652824.ask
004400281652824.RPL

File name: 004400281652824.RPL
Files of type: Rpl files (*.rpl)
☐ Open as read-only

The name of the file and the path where it is located are shown.

vii To write the file to phone, click **Start**.



Certificate Restore
Start
Close
Help
Browse
Browse

Action
○ Generate a request file
● Process a response file

Place for request file
Filename: C:\Temp\IMEI\004400281652824.ask

Place for response file
Filename: C:\Temp\IMEI\004400281652824.RPL

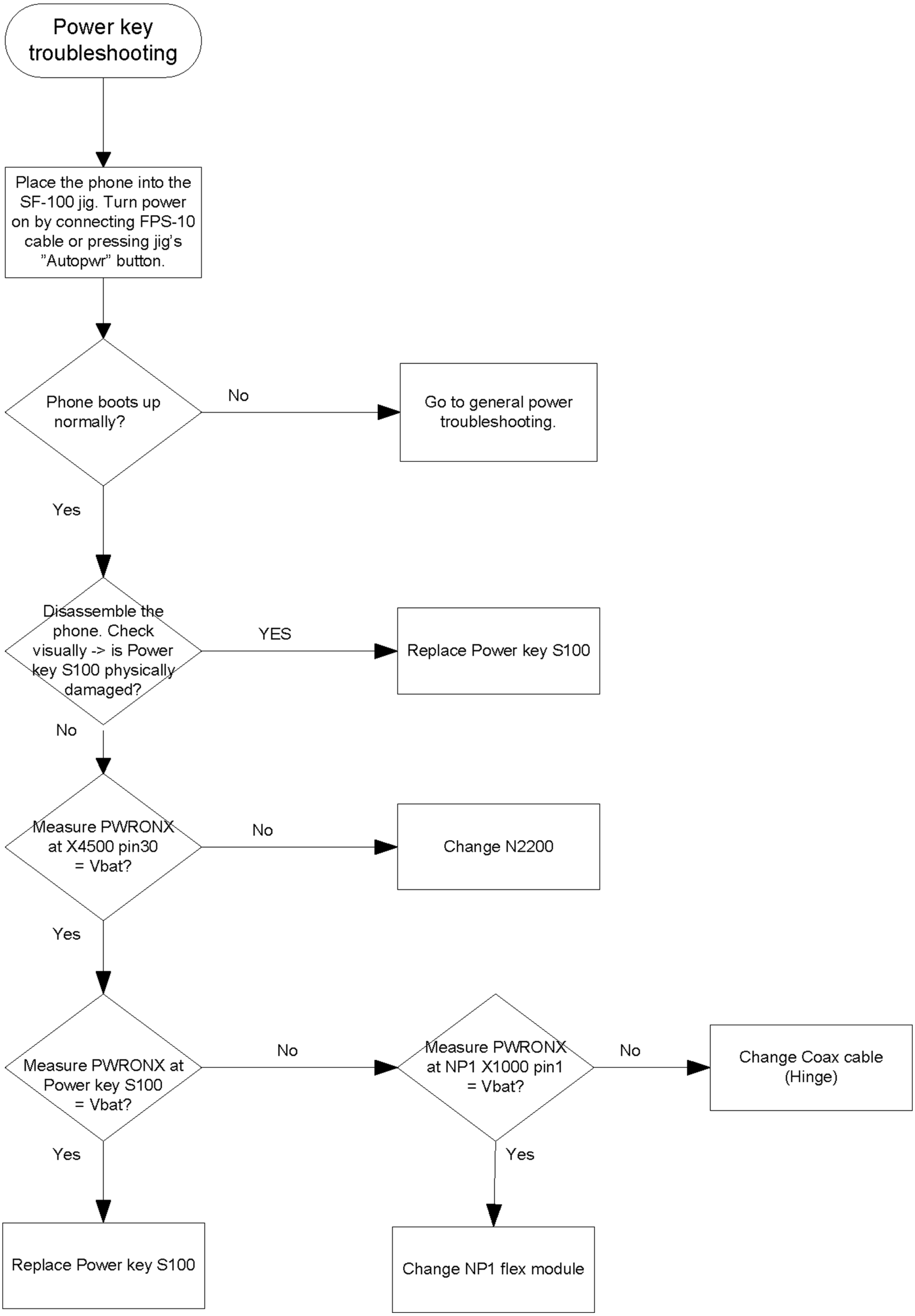
Next actions

After a successful rewrite, you must retune the phone completely by using *Phoenix* tuning functions.

Important: Perform all tunings: RF, BB, and UI.

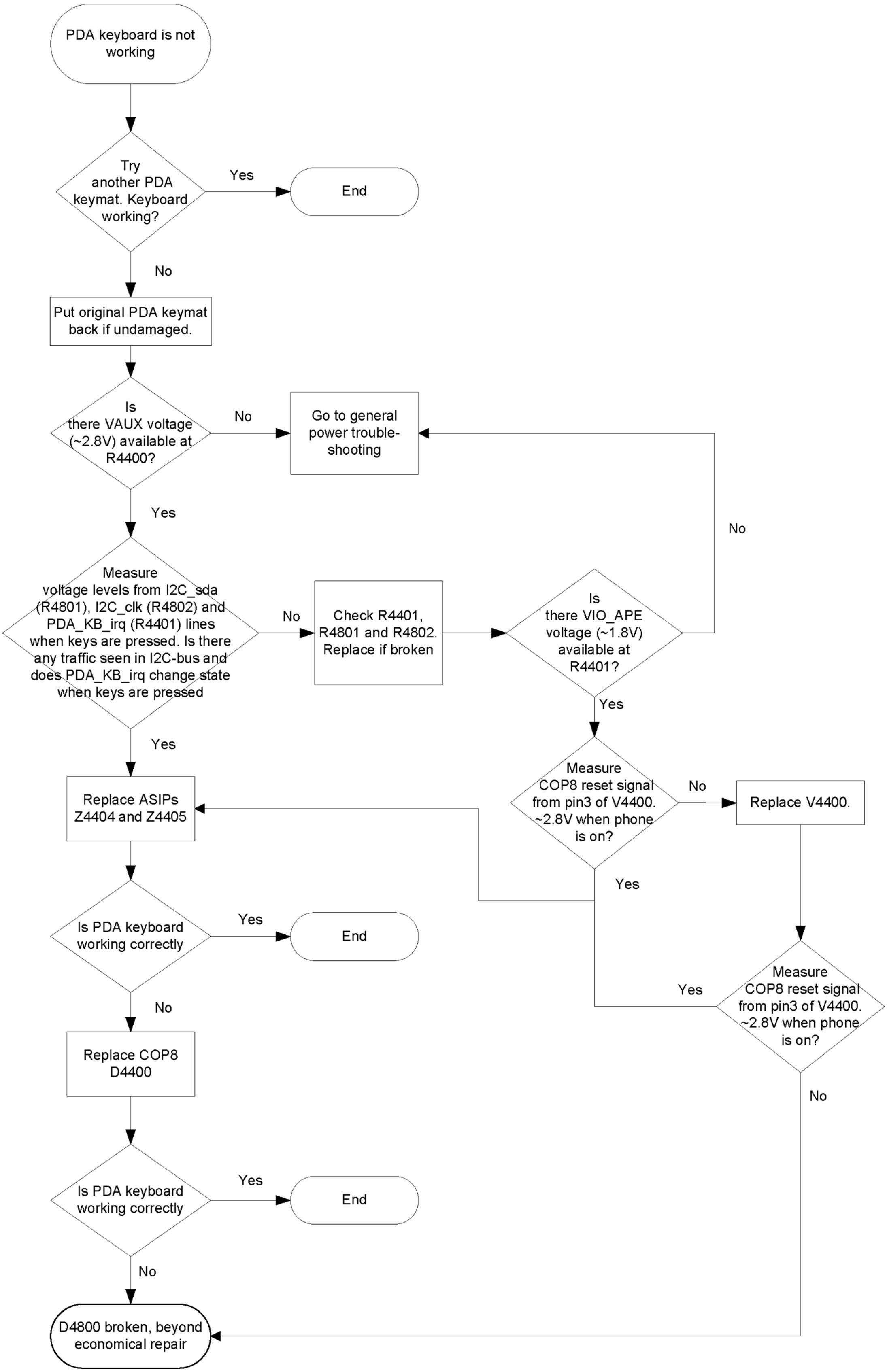
Power key troubleshooting

Troubleshooting flow


Power key troubleshooting
Place the phone into the SF-100 jig. Turn power on by connecting FPS-10 cable or pressing jig's "Autopwr" button.
Phone boots up normally?
No
Go to general power troubleshooting.
Yes
Disassemble the phone. Check visually -> is Power key S100 physically damaged?
YES
Replace Power key S100
No
Measure PWRONX at X4500 pin30 = Vbat?
No
Change N2200
Yes
Measure PWRONX at Power key S100 = Vbat?
No
Measure PWRONX at NP1 X1000 pin1 = Vbat?
No
Change Coax cable (Hinge)
Yes
Replace Power key S100
Yes
Change NP1 flex module

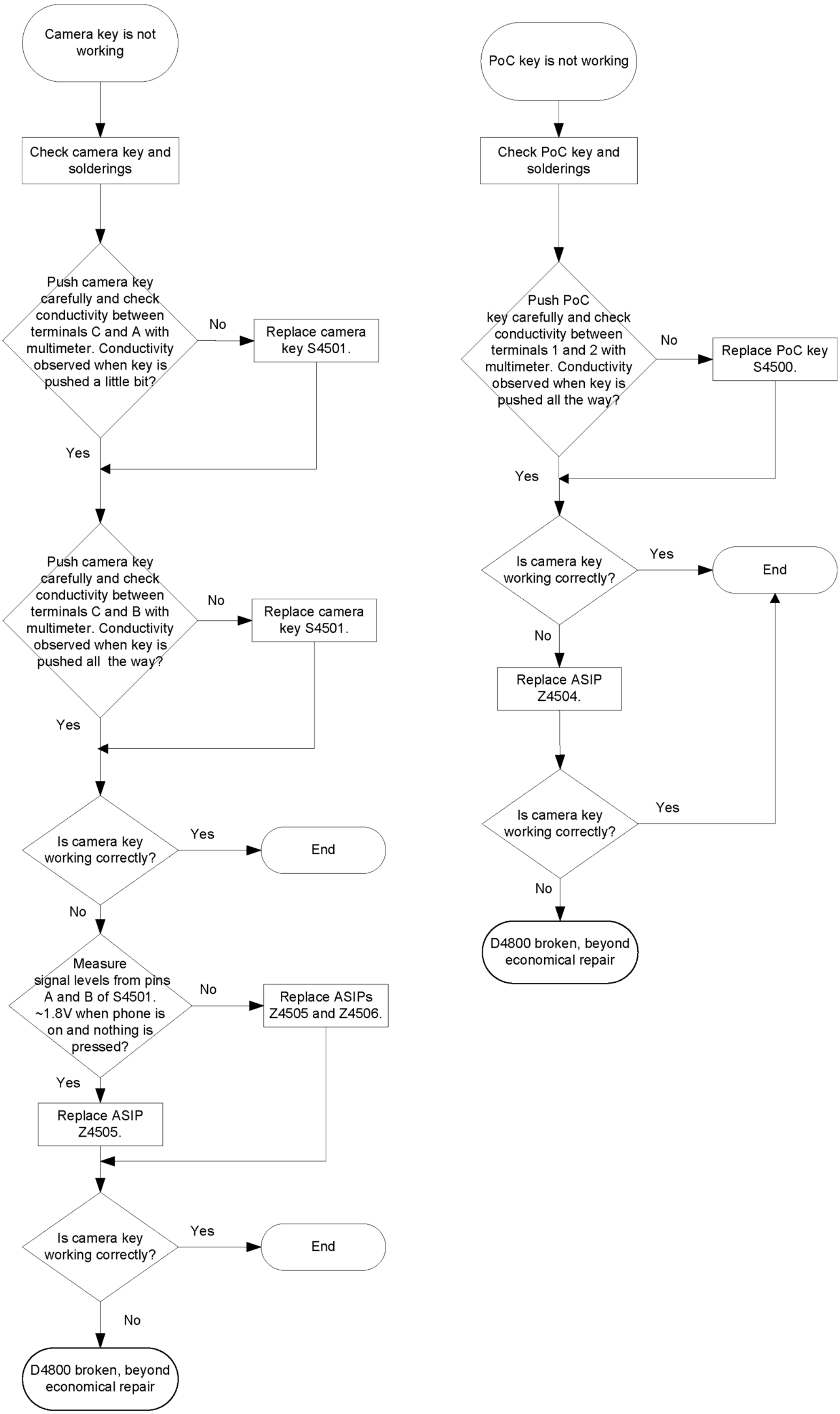
PDA keyboard troubleshooting

Troubleshooting flow


PDA keyboard is not working
Try another PDA keymat. Keyboard working?
Yes
End
No
Put original PDA keymat back if undamaged.
Is there VAUX voltage (~2.8V) available at R4400?
No
Go to general power trouble-shooting
Yes
Measure voltage levels from I2C_sda (R4801), I2C_clk (R4802) and PDA_KB_irq (R4401) lines when keys are pressed. Is there any traffic seen in I2C-bus and does PDA_KB_irq change state when keys are pressed
No
Check R4401, R4801 and R4802. Replace if broken
Is there VIO_APE voltage (~1.8V) available at R4401?
No
Yes
Yes
Replace ASIPs Z4404 and Z4405
Measure COP8 reset signal from pin3 of V4400. ~2.8V when phone is on?
No
Replace V4400.
Yes
Is PDA keyboard working correctly
Yes
End
No
Replace COP8 D4400
Yes
Measure COP8 reset signal from pin3 of V4400. ~2.8V when phone is on?
No
Is PDA keyboard working correctly
Yes
End
No
D4800 broken, beyond economical repair

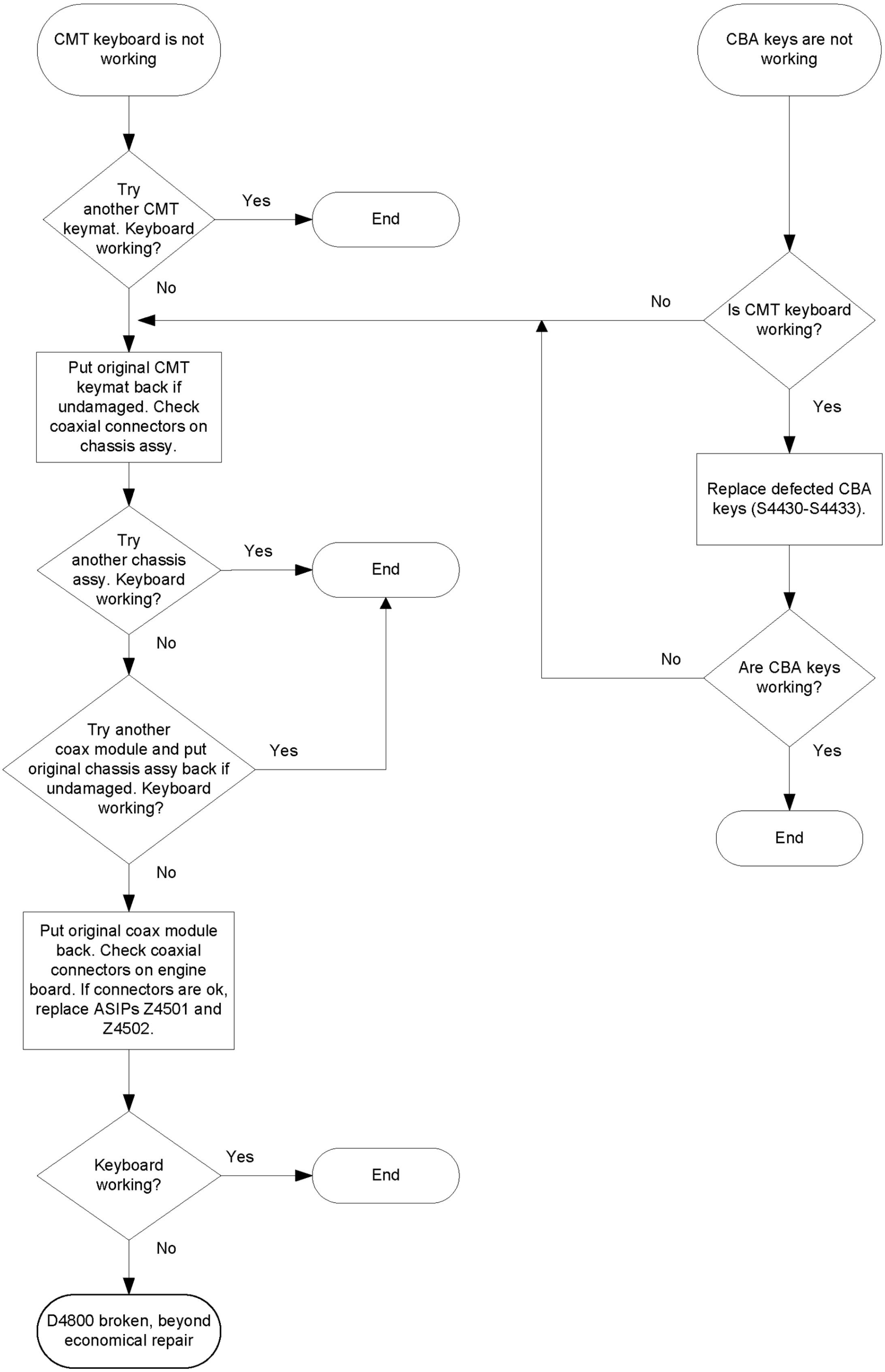
Camera and PoC key troubleshooting

Troubleshooting flow


Camera key is not working
Check camera key and solderings
Push camera key carefully and check conductivity between terminals C and A with multimeter. Conductivity observed when key is pushed a little bit?
No
Replace camera key S4501.
Yes
Push camera key carefully and check conductivity between terminals C and B with multimeter. Conductivity observed when key is pushed all the way?
No
Replace camera key S4501.
Yes
Is camera key working correctly?
Yes
End
No
Measure signal levels from pins A and B of S4501. ~1.8V when phone is on and nothing is pressed?
No
Replace ASIPs Z4505 and Z4506.
Yes
Replace ASIP Z4505.
Is camera key working correctly?
Yes
End
No
D4800 broken, beyond economical repair
PoC key is not working
Check PoC key and solderings
Push PoC key carefully and check conductivity between terminals 1 and 2 with multimeter. Conductivity observed when key is pushed all the way?
No
Replace PoC key S4500.
Yes
Is camera key working correctly?
Yes
End
No
Replace ASIP Z4504.
Is camera key working correctly?
Yes
No
D4800 broken, beyond economical repair

CMT keyboard CBA keys troubleshooting

Troubleshooting flow


CMT keyboard is not working
Try another CMT keymat. Keyboard working?
Yes
End
No
Put original CMT keymat back if undamaged. Check coaxial connectors on chassis assy.
Try another chassis assy. Keyboard working?
Yes
End
No
Try another coax module and put original chassis assy back if undamaged. Keyboard working?
Yes
No
Put original coax module back. Check coaxial connectors on engine board. If connectors are ok, replace ASIPs Z4501 and Z4502.
Keyboard working?
Yes
End
No
D4800 broken, beyond economical repair
CBA keys are not working
Is CMT keyboard working?
No
Yes
Replace defected CBA keys (S4430-S4433).
Are CBA keys working?
No
Yes
End

Display module troubleshooting

General instructions for display troubleshooting

Context

- The display is in a normal mode when the phone is in active use.
- Display is in a partial idle mode when the phone is in the screen saver mode.
- The operating modes of the display can be controlled with the help of *Phoenix*.

Table 6 Display module troubleshooting cases

Display blank	There is no image on the display. The display looks the same when the phone is on as it does when the phone is off. The backlight can be on in some cases.
Image on the display not correct	Image on the display can be corrupted or a part of the image can be missing. If a part of the image is missing, change the display module. If the image is otherwise corrupted, follow the appropriate troubleshooting diagram.
Backlight dim or not working at all	Backlight LED components are inside the display module. Backlight failure can also be in the connector or in the backlight power source in the main engine of the phone. This means that in case the display is working (image OK), the backlight is faulty.
Visual defects (pixel)	Pixel defects can be checked by controlling the display with Phoenix. Use both colours, black and white, on a full screen. The display may have some random pixel defects that are acceptable for this type of display. The criteria when pixel defects are regarded as a display failure, resulting in a replacement of the display, are presented the following table.

Table 7 Pixel defects

Item		White dot defect				Black dot defect	Total
1	Defect counts	R	G	B	White Dot Total	1	1
		1	1	1	1		
2	Combined defect counts	Not allowed. Two single dot defects that are within 5 mm of each other should be interpreted as combined dot defect.					

Steps

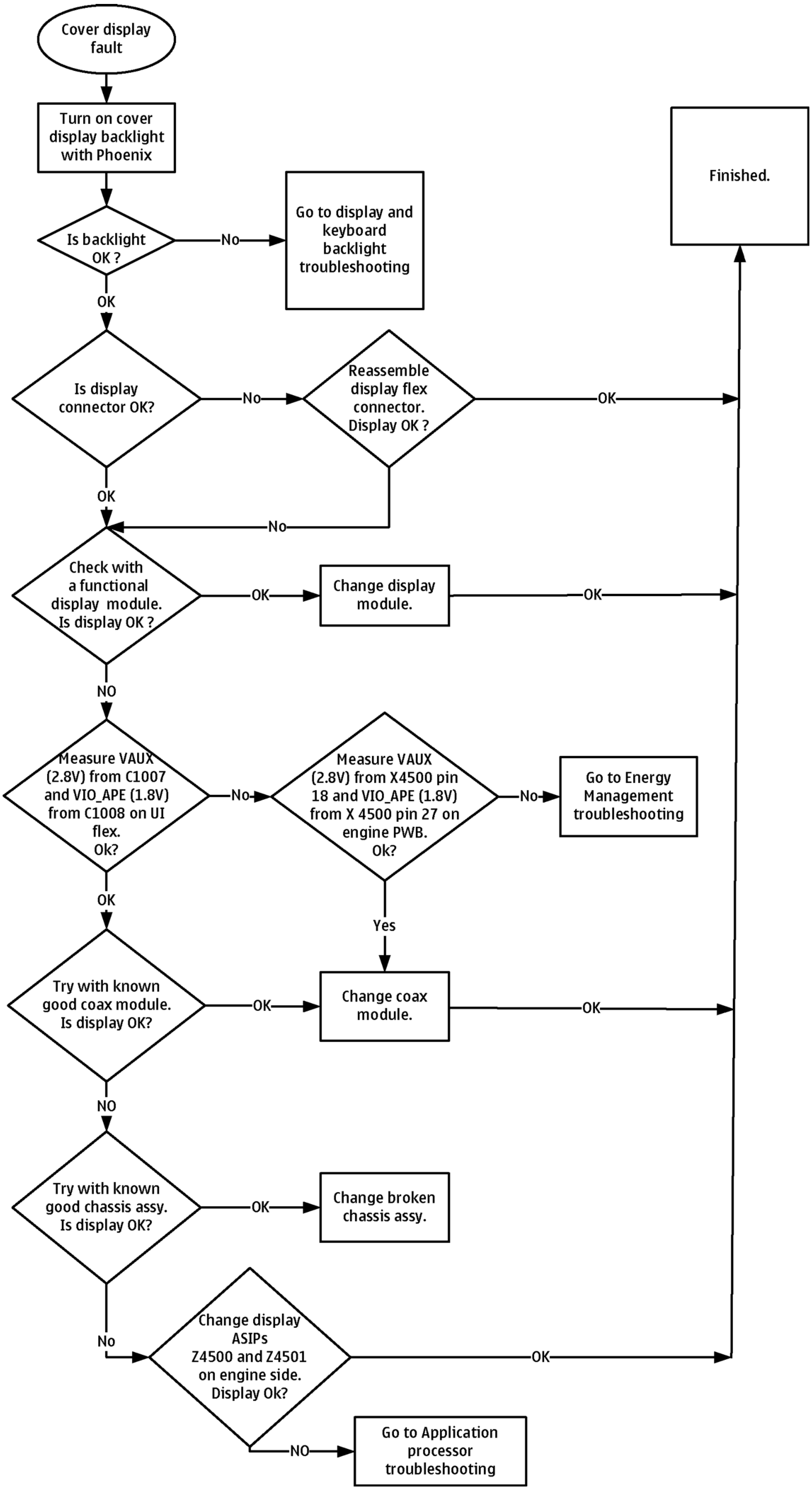
1. Verify with a working display that the fault is not on the display module itself.

   The display module cannot be repaired.
2. Check that the cellular engine is working normally.
   - i To check the functionality, connect the phone to a docking station.
   - ii Start *Phoenix* service software.
   - iii Read the phone information to check that also the application engine is functioning normally (you should be able to read the APE ID).
3. Proceed to the display troubleshooting flowcharts.

   Use the **Display Test** tool in *Phoenix* to find the detailed fault mode.

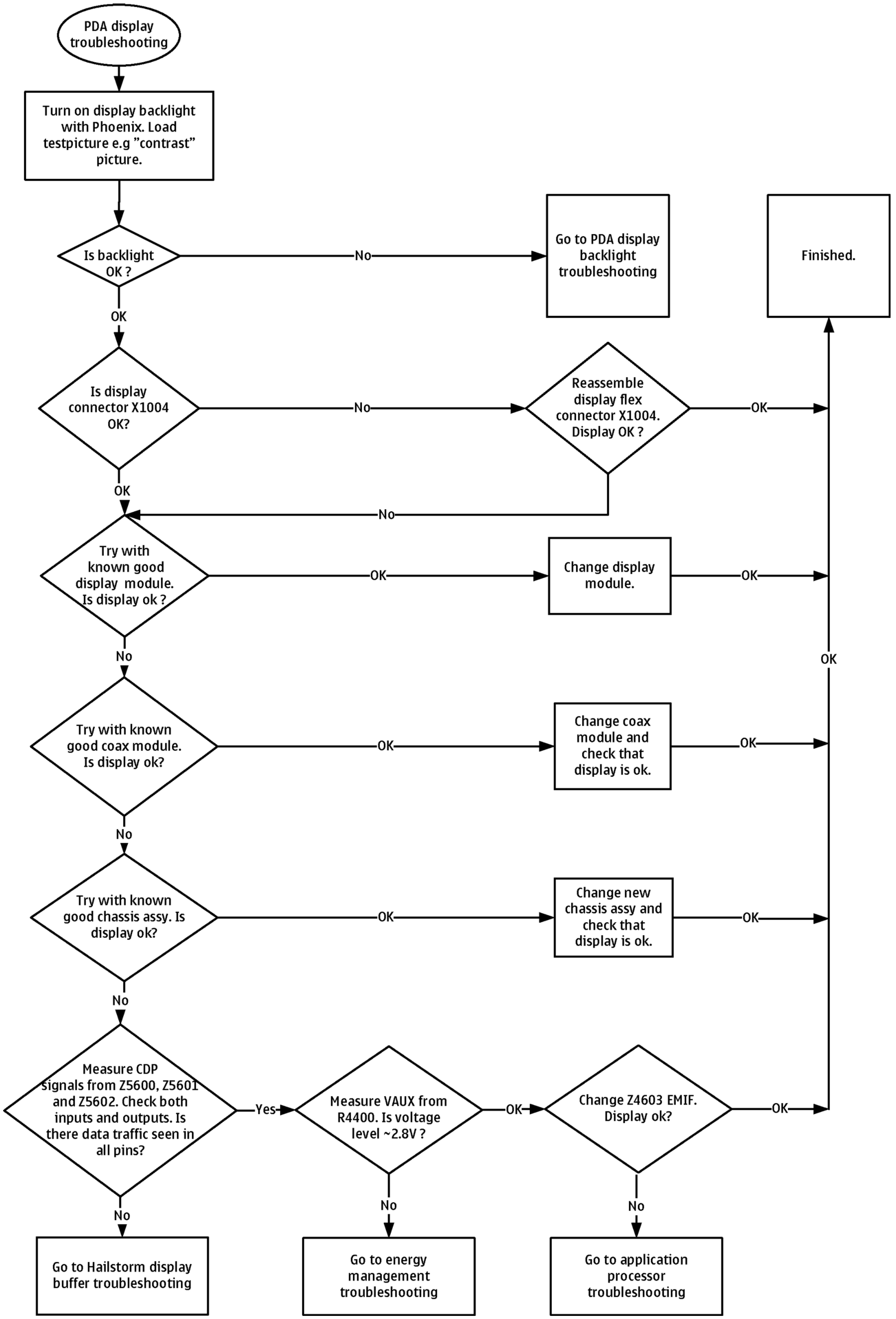
Cover display troubleshooting

Troubleshooting flow


Cover display fault
Turn on cover display backlight with Phoenix
Is backlight OK ?
No
Go to display and keyboard backlight troubleshooting
Finished.
OK
Is display connector OK?
No
Reassemble display flex connector. Display OK ?
OK
OK
No
Check with a functional display module. Is display OK ?
OK
Change display module.
OK
NO
Measure VAUX (2.8V) from C1007 and VIO_APE (1.8V) from C1008 on UI flex. Ok?
No
Measure VAUX (2.8V) from X4500 pin 18 and VIO_APE (1.8V) from X 4500 pin 27 on engine PWB. Ok?
No
Go to Energy Management troubleshooting
OK
Yes
Try with known good coax module. Is display OK?
OK
Change coax module.
OK
NO
Try with known good chassis assy. Is display OK?
OK
Change broken chassis assy.
No
Change display ASIPs Z4500 and Z4501 on engine side. Display Ok?
OK
NO
Go to Application processor troubleshooting

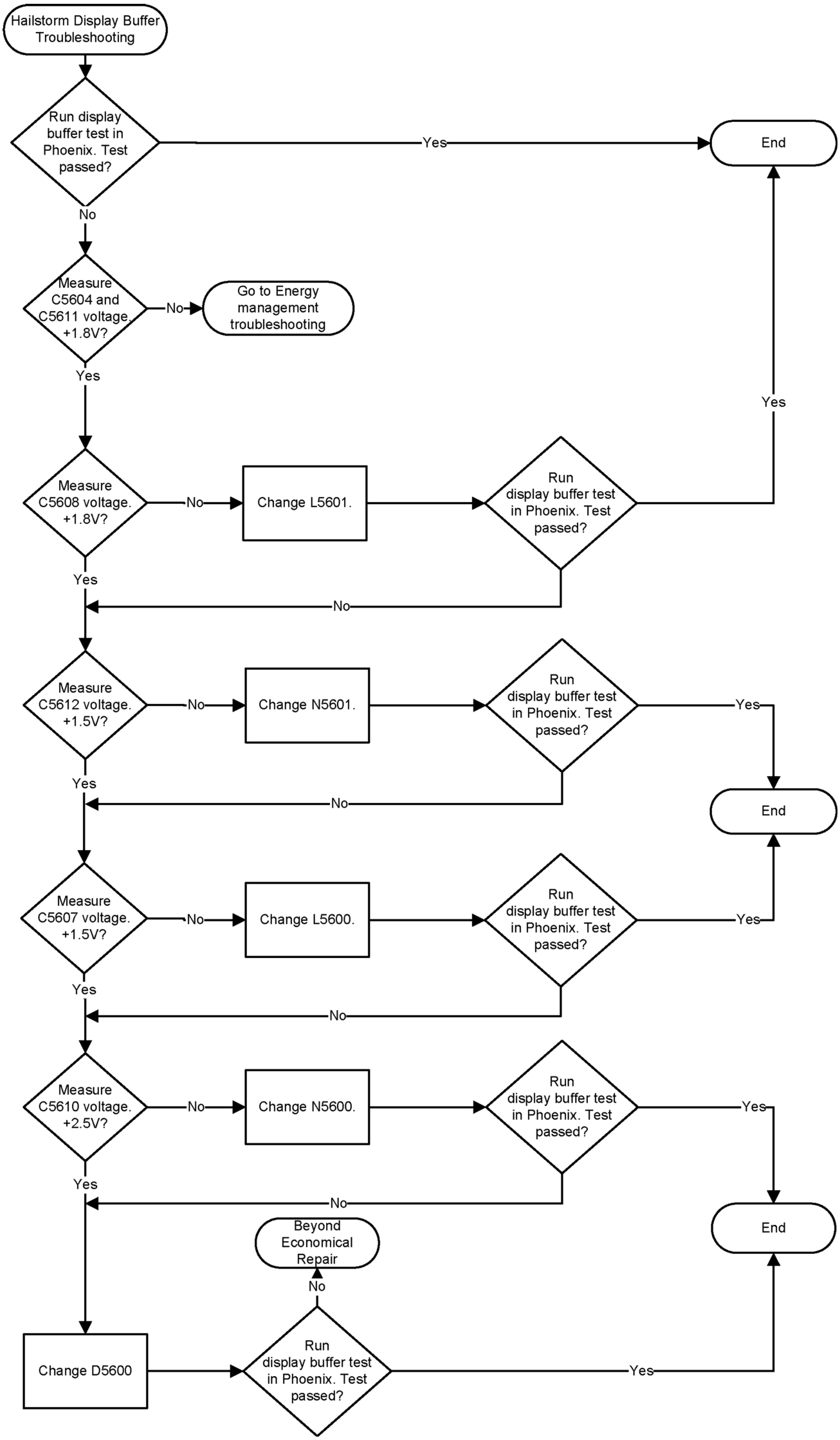
PDA display troubleshooting

Troubleshooting flow


PDA display troubleshooting
Turn on display backlight with Phoenix. Load testpicture e.g ”contrast” picture.
Is backlight OK ?
No
Go to PDA display backlight troubleshooting
Finished.
OK
Is display connector X1004 OK?
No
Reassemble display flex connector X1004. Display OK ?
OK
OK
No
Try with known good display module. Is display ok ?
OK
Change display module.
OK
OK
No
Try with known good coax module. Is display ok?
OK
Change coax module and check that display is ok.
OK
No
Try with known good chassis assy. Is display ok?
OK
Change new chassis assy and check that display is ok.
OK
No
Measure CDP signals from Z5600, Z5601 and Z5602. Check both inputs and outputs. Is there data traffic seen in all pins?
Yes
Measure VAUX from R4400. Is voltage level ~2.8V ?
OK
Change Z4603 EMIF. Display ok?
OK
No
No
No
Go to Hailstorm display buffer troubleshooting
Go to energy management troubleshooting
Go to application processor troubleshooting

Display buffer troubleshooting

Troubleshooting flow


Hailstorm Display Buffer Troubleshooting
Run display buffer test in Phoenix. Test passed?
Yes
End
No
Measure C5604 and C5611 voltage. +1.8V?
No
Go to Energy management troubleshooting
Yes
Measure C5608 voltage. +1.8V?
No
Change L5601.
Run display buffer test in Phoenix. Test passed?
Yes
No
Yes
Measure C5612 voltage. +1.5V?
No
Change N5601.
Run display buffer test in Phoenix. Test passed?
Yes
End
No
Yes
Measure C5607 voltage. +1.5V?
No
Change L5600.
Run display buffer test in Phoenix. Test passed?
Yes
No
Yes
Measure C5610 voltage. +2.5V?
No
Change N5600.
Run display buffer test in Phoenix. Test passed?
Yes
End
No
Yes
Beyond Economical Repair
No
Change D5600
Run display buffer test in Phoenix. Test passed?
Yes

ALS troubleshooting

Context

- If a phototransistor is broken, replace it with a typical phototransistor.
- After replacing the phototransistor or if calibration values are lost for some other reason, ALS re-tuning is required.
- Before starting the ALS calibration procedure, perform the 'Pull-up resistor calibration' in dark lighting conditions, and write the measured 'correction' value to the phone. After this ALS calibration procedure is performed, and the default co-efficient value '1' is written to the phone.
- Make sure that you have completed **Display and keypad backlight troubleshooting** first before starting **ALS troubleshooting**.

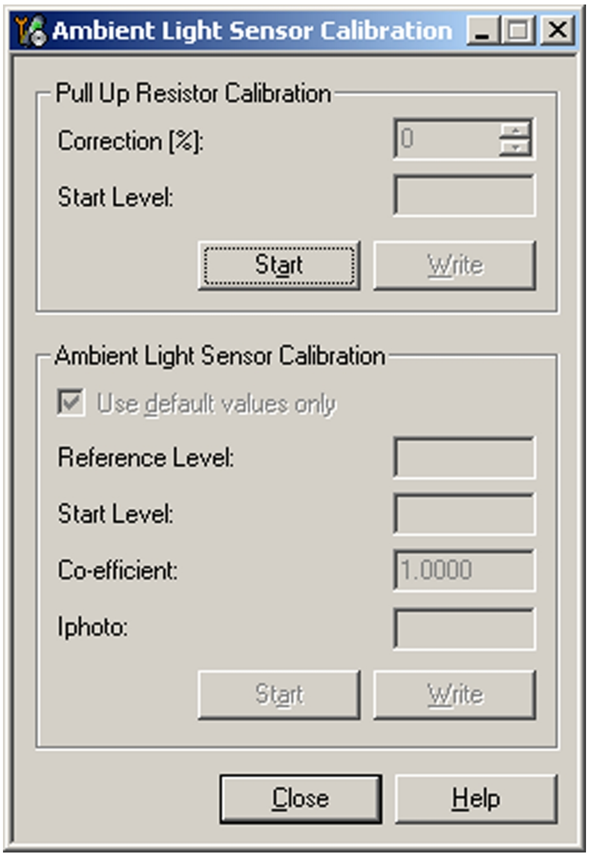
Here are some hints for ALS troubleshooting; the following troubleshooting diagram refers to these:

- *Phoenix* LED control tool also shows you luminance. The correct luminance in darkness is <20 lx, and in office environment 100-2000 lx. The luminance value depends strongly on the light source and the angle of the phone, so these values are only a rough guideline.
- LED driver control voltage measurement points can be found from the **LED driver troubleshooting** section. When backlight brightness is set to 100%, both GENOUT signals are low, and enable PWM is 100%.
- *Phoenix* has an ambient light sensor calibration tool for changing calibration values. The pull-up resistor calibration is done first. See the following procedure.

Steps

1. Cover the light guide (upper part of the A-Cover).
2. Start *Phoenix*.
3. Choose **File→Scan Product.**

4. Choose **Tuning→Ambient Light Sensor Calibration.**


Ambient Light Sensor Calibration
Pull Up Resistor Calibration
Start Level:
Start
Write
Ambient Light Sensor Calibration
Reference Level:
Start Level:
Iphoto:
Start
Write
Close
Help

Correction [%]: 0

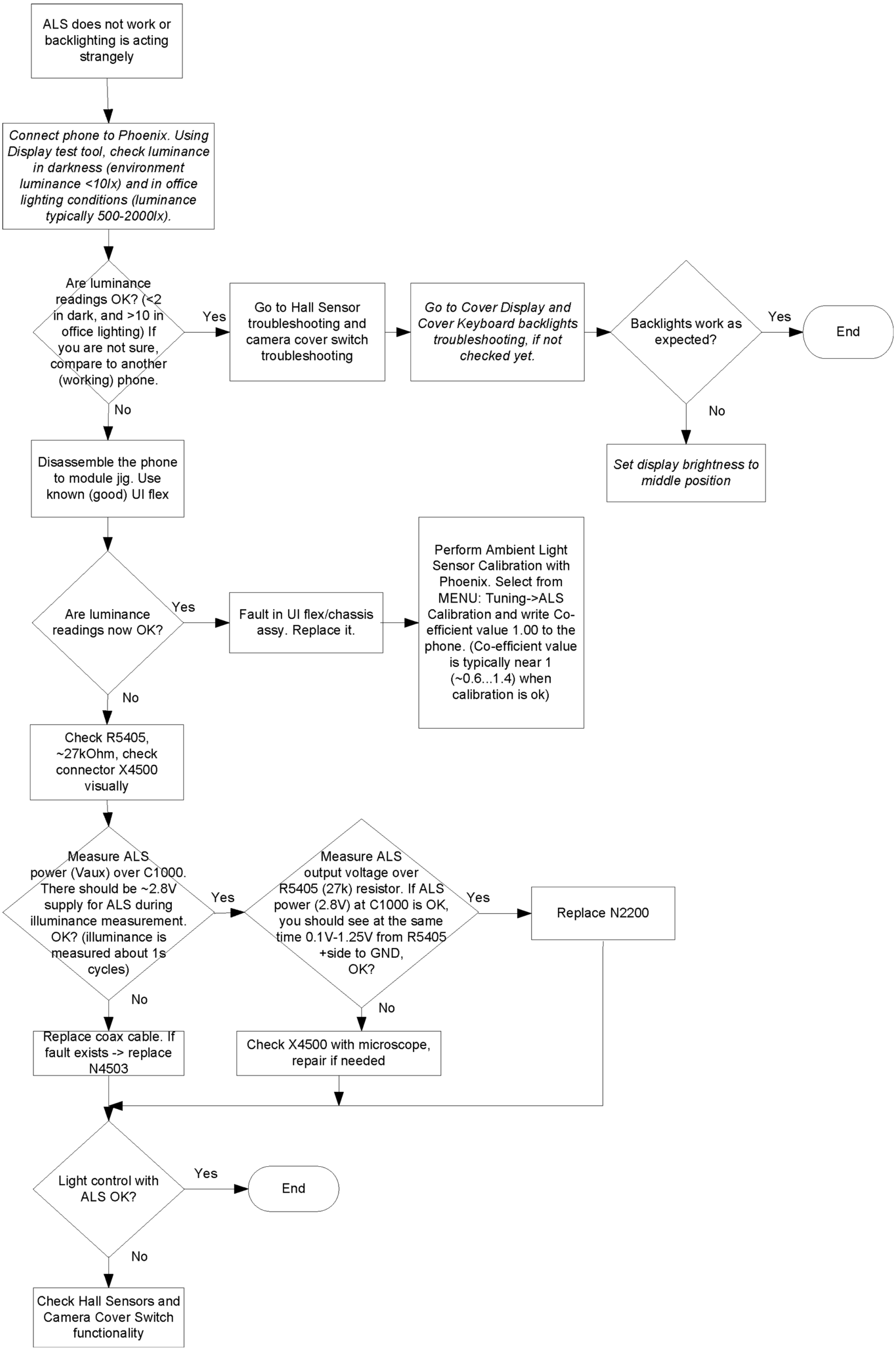
☑ Use default values only

Co-efficient: 1.0000

Figure 9 ***Ambient Light Sensor Calibration*** **window**

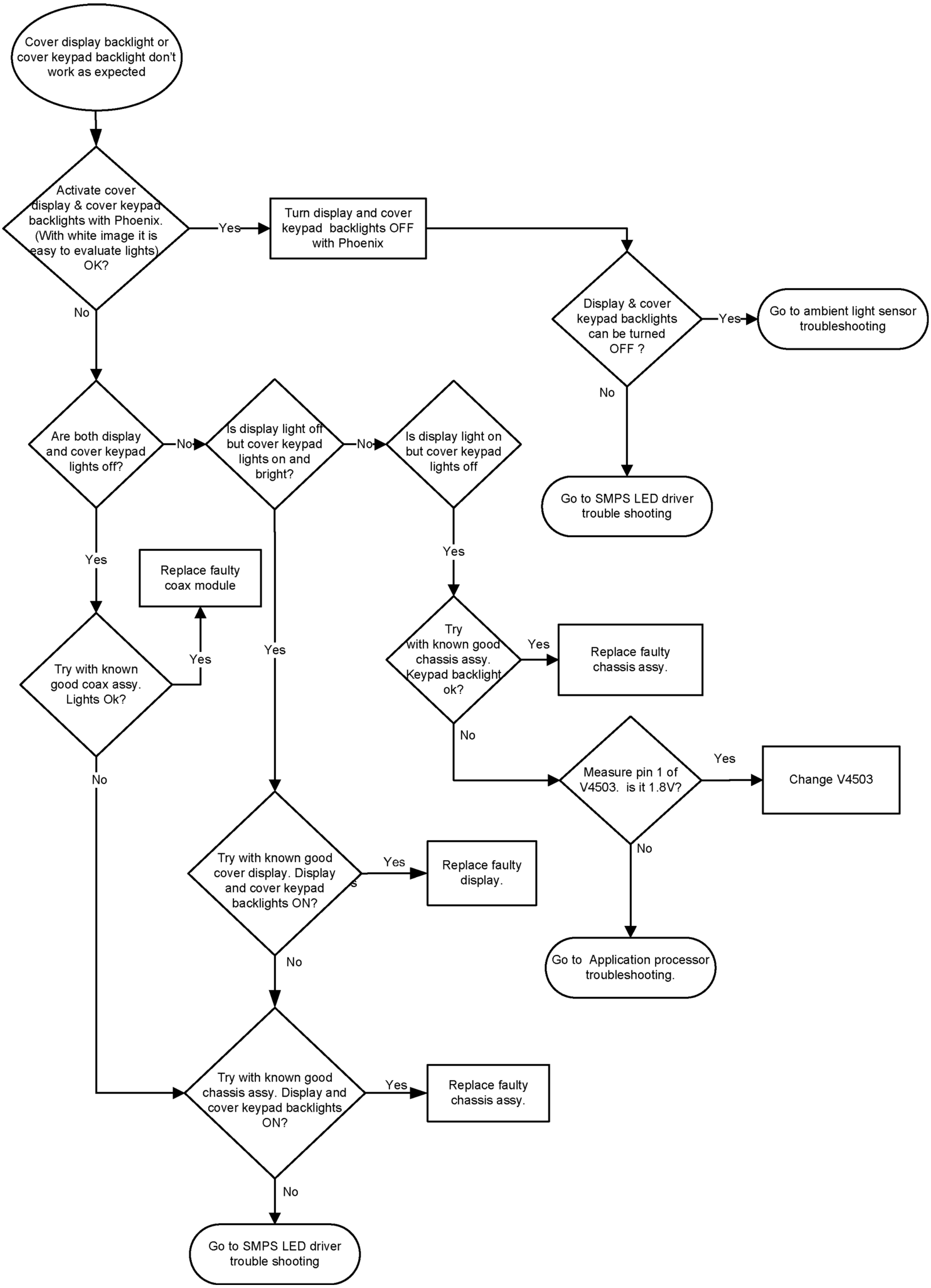
5. In the *Pull Up Resistor Calibration* pane, click **Start**, and **Write**.
6. In the *Ambient Light Sensor Calibration* pane, check the **Use default values only** check box, and click **Write**.
7. To end the calibration, click **Close**.

Troubleshooting flow


ALS does not work or backlighting is acting strangely
Connect phone to Phoenix. Using Display test tool, check luminance in darkness (environment luminance <10lx) and in office lighting conditions (luminance typically 500-2000lx).
Are luminance readings OK? (<2 in dark, and >10 in office lighting) If you are not sure, compare to another (working) phone.
Yes
Go to Hall Sensor troubleshooting and camera cover switch troubleshooting
Go to Cover Display and Cover Keyboard backlights troubleshooting, if not checked yet.
Backlights work as expected?
Yes
End
No
Set display brightness to middle position
No
Disassemble the phone to module jig. Use known (good) UI flex
Are luminance readings now OK?
Yes
Fault in UI flex/chassis assy. Replace it.
Perform Ambient Light Sensor Calibration with Phoenix. Select from MENU: Tuning->ALS Calibration and write Co-efficient value 1.00 to the phone. (Co-efficient value is typically near 1 (~0.6...1.4) when calibration is ok)
No
Check R5405, ~27kOhm, check connector X4500 visually
Measure ALS power (Vaux) over C1000. There should be ~2.8V supply for ALS during illuminance measurement. OK? (illuminance is measured about 1s cycles)
Yes
Measure ALS output voltage over R5405 (27k) resistor. If ALS power (2.8V) at C1000 is OK, you should see at the same time 0.1V-1.25V from R5405 +side to GND, OK?
Yes
Replace N2200
No
Replace coax cable. If fault exists -> replace N4503
No
Check X4500 with microscope, repair if needed
Light control with ALS OK?
Yes
End
No
Check Hall Sensors and Camera Cover Switch functionality

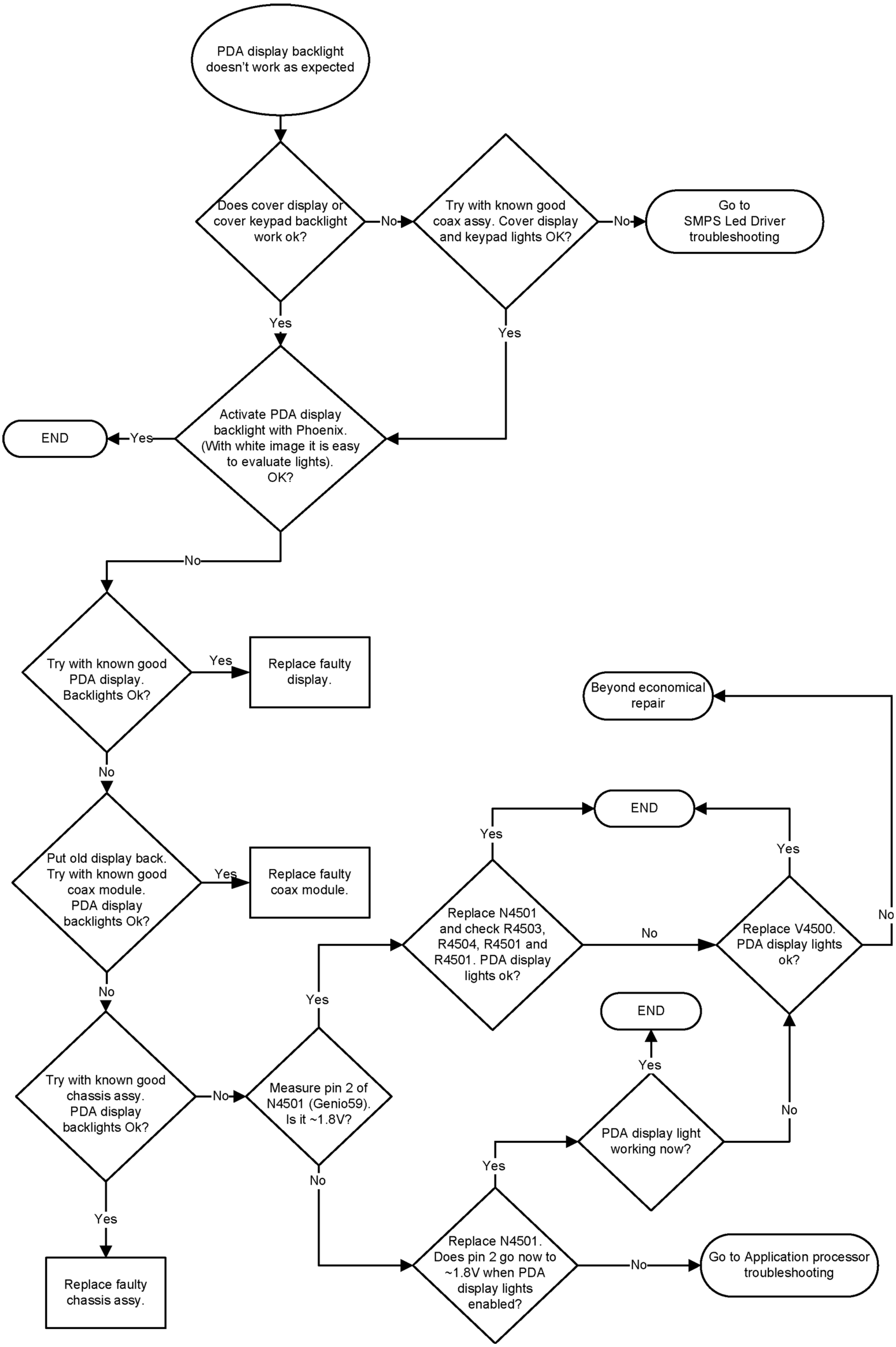
Cover display and cover keyboard backlight troubleshooting

Troubleshooting flow


Cover display backlight or cover keypad backlight don't work as expected
Activate cover display & cover keypad backlights with Phoenix. (With white image it is easy to evaluate lights) OK?
Yes
Turn display and cover keypad backlights OFF with Phoenix
Display & cover keypad backlights can be turned OFF ?
Yes
Go to ambient light sensor troubleshooting
No
Go to SMPS LED driver trouble shooting
No
Are both display and cover keypad lights off?
No
Is display light off but cover keypad lights on and bright?
No
Is display light on but cover keypad lights off
Yes
Replace faulty coax module
Yes
Try with known good coax assy. Lights Ok?
Yes
Yes
Try with known good chassis assy. Keypad backlight ok?
Yes
Replace faulty chassis assy.
No
Measure pin 1 of V4503. is it 1.8V?
Yes
Change V4503
No
Go to Application processor troubleshooting.
No
Try with known good cover display. Display and cover keypad backlights ON?
Yes
Replace faulty display.
No
Try with known good chassis assy. Display and cover keypad backlights ON?
Yes
Replace faulty chassis assy.
No
Go to SMPS LED driver trouble shooting

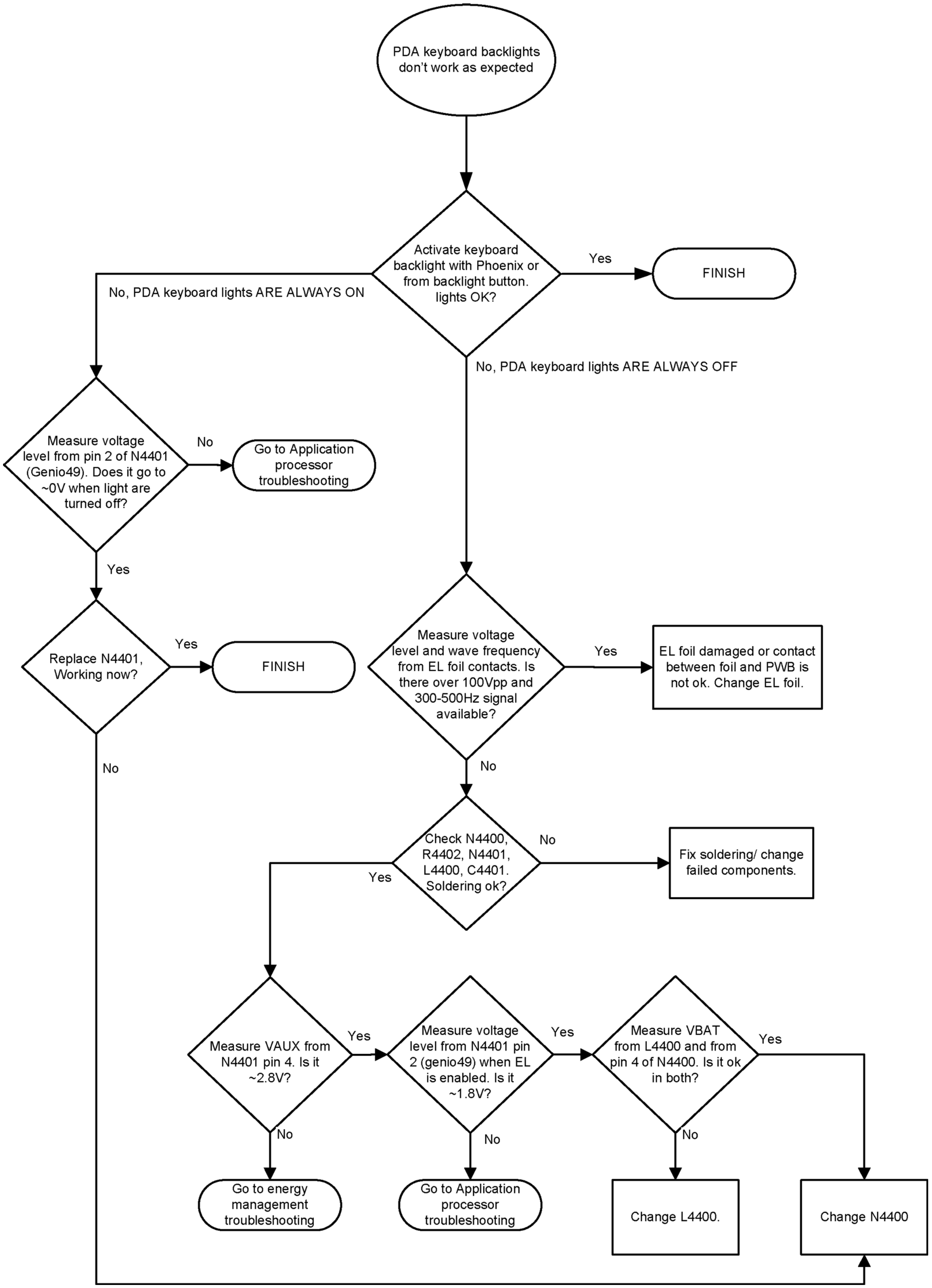
PDA display backlight troubleshooting

Troubleshooting flow


PDA display backlight doesn't work as expected
Does cover display or cover keypad backlight work ok?
No
Try with known good coax assy. Cover display and keypad lights OK?
No
Go to SMPS Led Driver troubleshooting
Yes
Yes
Activate PDA display backlight with Phoenix. (With white image it is easy to evaluate lights). OK?
Yes
END
No
Try with known good PDA display. Backlights Ok?
Yes
Replace faulty display.
No
Put old display back. Try with known good coax module. PDA display backlights Ok?
Yes
Replace faulty coax module.
No
Try with known good chassis assy. PDA display backlights Ok?
Yes
Replace faulty chassis assy.
No
Measure pin 2 of N4501 (Genio59). Is it ~1.8V?
Yes
Replace N4501 and check R4503, R4504, R4501 and R4501. PDA display lights ok?
Yes
END
No
Replace V4500. PDA display lights ok?
Yes
END
No
Beyond economical repair
No
Replace N4501. Does pin 2 go now to ~1.8V when PDA display lights enabled?
No
Go to Application processor troubleshooting
Yes
PDA display light working now?
Yes
END
No

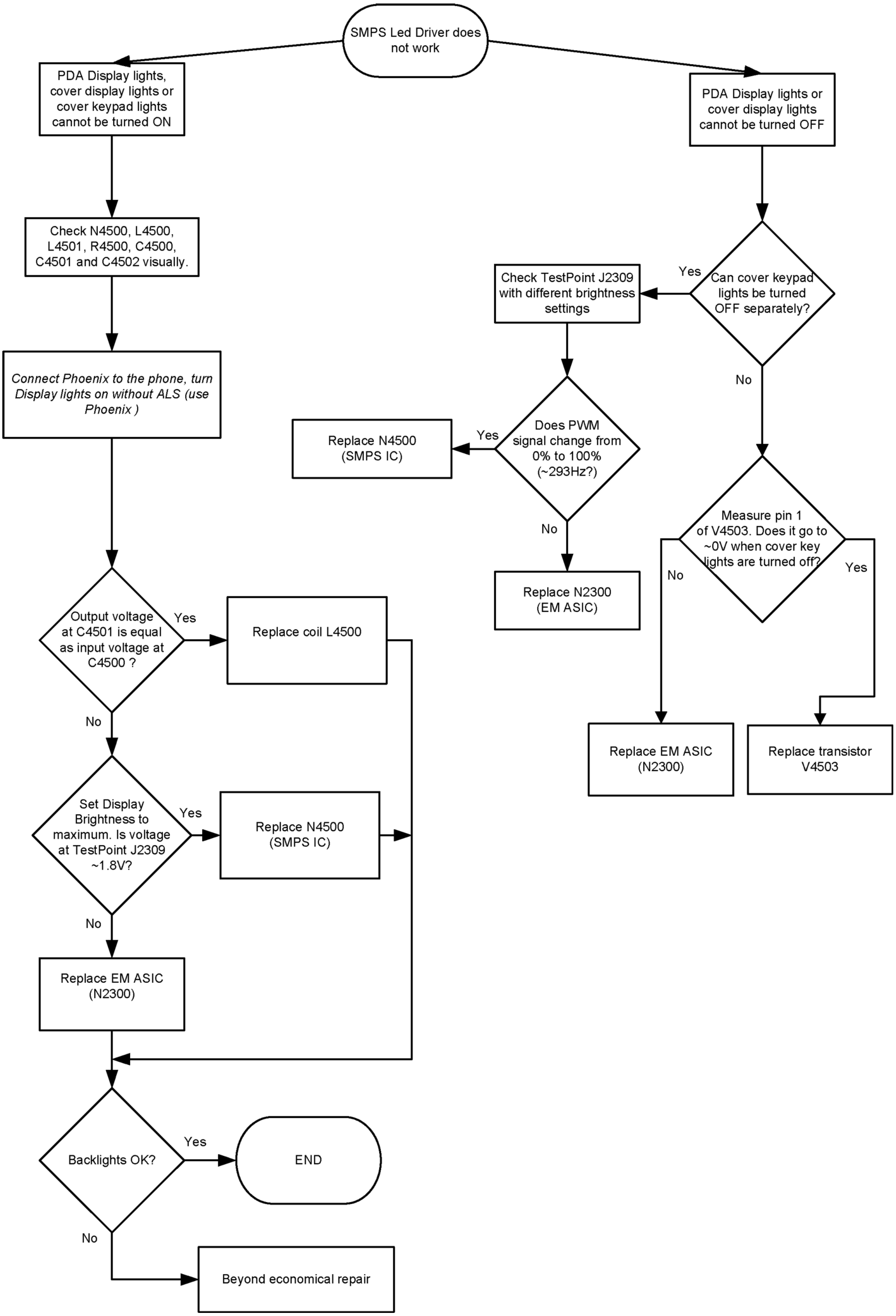
PDA keyboard backlight troubleshooting

Troubleshooting flow


PDA keyboard backlights don't work as expected
Activate keyboard backlight with Phoenix or from backlight button. lights OK?
Yes
FINISH
No, PDA keyboard lights ARE ALWAYS ON
No, PDA keyboard lights ARE ALWAYS OFF
Measure voltage level from pin 2 of N4401 (Genio49). Does it go to ~0V when light are turned off?
No
Go to Application processor troubleshooting
Yes
Replace N4401, Working now?
Yes
FINISH
No
Measure voltage level and wave frequency from EL foil contacts. Is there over 100Vpp and 300-500Hz signal available?
Yes
EL foil damaged or contact between foil and PWB is not ok. Change EL foil.
No
Check N4400, R4402, N4401, L4400, C4401. Soldering ok?
No
Fix soldering/ change failed components.
Yes
Measure VAUX from N4401 pin 4. Is it ~2.8V?
Yes
No
Go to energy management troubleshooting
Measure voltage level from N4401 pin 2 (genio49) when EL is enabled. Is it ~1.8V?
Yes
No
Go to Application processor troubleshooting
Measure VBAT from L4400 and from pin 4 of N4400. Is it ok in both?
Yes
No
Change L4400.
Change N4400

SMPS led driver troubleshooting

Troubleshooting flow


SMPS Led Driver does not work
PDA Display lights, cover display lights or cover keypad lights cannot be turned ON
Check N4500, L4500, L4501, R4500, C4500, C4501 and C4502 visually.
Connect Phoenix to the phone, turn Display lights on without ALS (use Phoenix)
Output voltage at C4501 is equal as input voltage at C4500 ?
Yes
Replace coil L4500
No
Set Display Brightness to maximum. Is voltage at TestPoint J2309 ~1.8V?
Yes
Replace N4500 (SMPS IC)
No
Replace EM ASIC (N2300)
Backlights OK?
Yes
END
No
Beyond economical repair
PDA Display lights or cover display lights cannot be turned OFF
Can cover keypad lights be turned OFF separately?
Yes
Check TestPoint J2309 with different brightness settings
Does PWM signal change from 0% to 100% (~293Hz?)
Yes
Replace N4500 (SMPS IC)
No
Replace N2300 (EM ASIC)
No
Measure pin 1 of V4503. Does it go to ~0V when cover key lights are turned off?
No
Replace EM ASIC (N2300)
Yes
Replace transistor V4503

Bluetooth troubleshooting

Introduction to Bluetooth troubleshooting

There are two main Bluetooth problems that can occur:

Problem	Description
Detachment of the BT antenna.	This would most likely happen if the device has been dropped repeatedly to the ground. It could cause the BT antenna to become loose or partially detached from the PWB. (see next page for details about BT antenna HW and Mechanics)
A malfunction in the BT ASIC, BB ASICs or Phone's BT SMD components.	This is unpredictable and could have many causes i.e. SW or HW related.

The main issue is to find out if the problem is related to the BT antenna or related to the BT system or the phone's BB and then replace/fix the faulty component.

Bluetooth settings for Phoenix

Steps

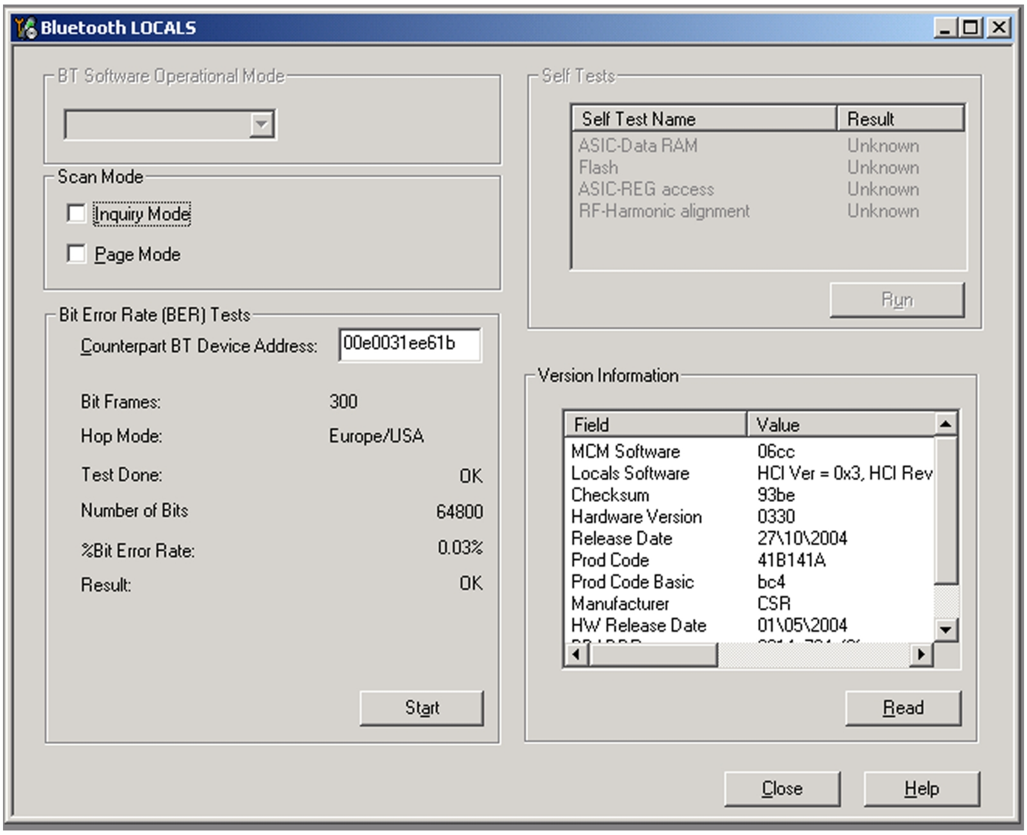
1. Start *Phoenix* service software.
2. From the **File** menu, choose **Open Product**, and then choose the correct type designator from the **Product** list.
3. Place the phone to a flash adapter in the local mode.
4. Choose **Testing**→**Bluetooth LOCALS** .
5. Locate JBT-9's serial number (12 digits) found in the type label on the back of JBT-9.

   In addition to JBT-9, also SB-6, JBT-3 and JBT-6 Bluetooth test boxes can be used.
6. In the *Bluetooth LOCALS* window, write the 12-digit serial number on the **Counterpart BT Device Address** line.

   This needs to be done only once provided that JBT-9 is not changed.
7. Place the JBT-9 box near (within 10 cm) the BT antenna and click **Run BER Test**.

Results

Bit Error Rate test result is displayed in the *Bit Error Rate (BER) Tests* pane in the *Bluetooth LOCALS* window.


Bluetooth LOCALS
BT Software Operational Mode
Scan Mode
Bit Error Rate (BER) Tests
Self Tests
Run
Version Information
Start
Read
Close
Help

☐ Inquiry Mode

☐ Page Mode

Counterpart BT Device Address: 00e0031ee61b

Bit Frames: 300

Hop Mode: Europe/USA

Test Done: OK

Number of Bits 64800

%Bit Error Rate: 0.03%

Result: OK

Self Test Name	Result
ASIC-Data RAM	Unknown
Flash	Unknown
ASIC-REG access	Unknown
RF-Harmonic alignment	Unknown

Field	Value
MCM Software	06cc
Locals Software	HCI Ver = 0x3, HCI Rev
Checksum	93be
Hardware Version	0330
Release Date	27\10\2004
Prod Code	41B141A
Prod Code Basic	bc4
Manufacturer	CSR
HW Release Date	01\05\2004

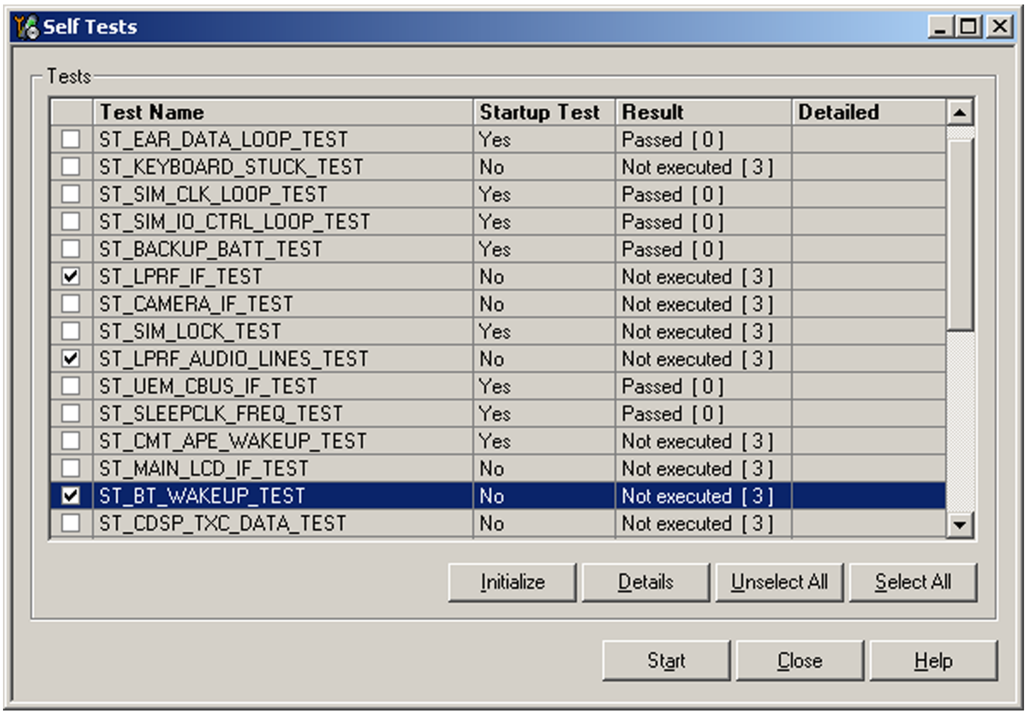
Figure 10 BER test result

Bluetooth self tests in Phoenix

Steps

1. Start *Phoenix* service software.
2. Choose**File→Scan Product.**
3. Place the phone to a flash adapter.
4. From the **Mode** drop-down menu, set mode to **Local**.
5. Choose **Testing→Self Tests.**
6. In the *Self Tests* window check the following Bluetooth related tests:
   - **ST_LPRF_IF_TEST**
   - **ST_LPRF_AUDIO_LINES_TEST**
   - **ST_BT_WAKEUP_TEST**

7. To run the tests, click **Start**.

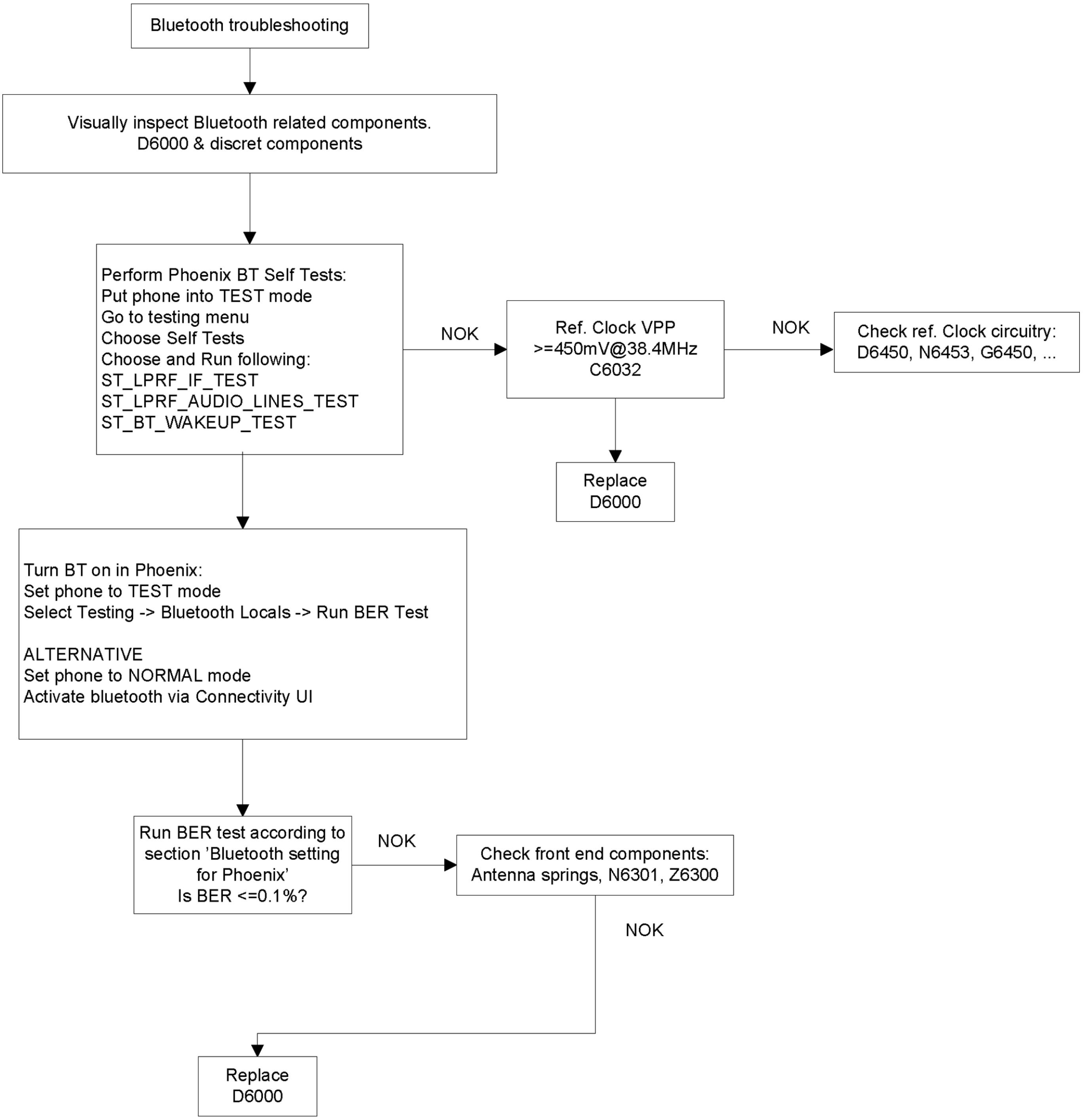


	Test Name	Startup Test	Result	Detailed
☐	ST_EAR_DATA_LOOP_TEST	Yes	Passed [0]	
☐	ST_KEYBOARD_STUCK_TEST	No	Not executed [3]	
☐	ST_SIM_CLK_LOOP_TEST	Yes	Passed [0]	
☐	ST_SIM_IO_CTRL_LOOP_TEST	Yes	Passed [0]	
☐	ST_BACKUP_BATT_TEST	Yes	Passed [0]	
☑	ST_LPRF_IF_TEST	No	Not executed [3]	
☐	ST_CAMERA_IF_TEST	No	Not executed [3]	
☐	ST_SIM_LOCK_TEST	Yes	Not executed [3]	
☑	ST_LPRF_AUDIO_LINES_TEST	No	Not executed [3]	
☐	ST_UEM_CBUS_IF_TEST	Yes	Passed [0]	
☐	ST_SLEEPCLK_FREQ_TEST	Yes	Passed [0]	
☐	ST_CMT_APE_WAKEUP_TEST	Yes	Not executed [3]	
☐	ST_MAIN_LCD_IF_TEST	No	Not executed [3]	
☑	ST_BT_WAKEUP_TEST	No	Not executed [3]	
☐	ST_CDSP_TXC_DATA_TEST	No	Not executed [3]	

Figure 11 Bluetooth self tests in *Phoenix*

Bluetooth troubleshooting

Troubleshooting flow


Bluetooth troubleshooting
Visually inspect Bluetooth related components. D6000 & discret components
Perform Phoenix BT Self Tests:
Put phone into TEST mode
Go to testing menu
Choose Self Tests
Choose and Run following:
ST_LPRF_IF_TEST
ST_LPRF_AUDIO_LINES_TEST
ST_BT_WAKEUP_TEST
NOK
Ref. Clock VPP >=450mV@38.4MHz C6032
NOK
Check ref. Clock circuitry: D6450, N6453, G6450, ...
Replace D6000
Turn BT on in Phoenix:
Set phone to TEST mode
Select Testing -> Bluetooth Locals -> Run BER Test
ALTERNATIVE
Set phone to NORMAL mode
Activate bluetooth via Connectivity UI
Run BER test according to section 'Bluetooth setting for Phoenix' Is BER <=0.1%?
NOK
Check front end components: Antenna springs, N6301, Z6300
NOK
Replace D6000

Audio troubleshooting

Audio troubleshooting test instructions

Differential external earpiece and internal earpiece outputs can be measured either with a single-ended or a differential probe.

When measuring with a single-ended probe each output is measured against the ground.

Internal handsfree output is measured using a current probe, if a special low-pass filter designed for measuring a digital amplifier is not available. Note also that when using a current probe, the input signal frequency must be set to 2 kHz.

The input signal for each loop test can be either single-ended or differential.

Required equipment

The following equipment is needed for the tests:

- Oscilloscope
- Function generator (sine waveform)
- 'Active speaker' or 'speaker and power amplifier'
- Sound level meter
- Current probe (Internal handsfree DPMA output measurement)
- Phoenix service software
- Battery voltage 3.7 V

Test procedure

Audio can be tested using the Phoenix audio routings option. Three different audio loop paths can be activated:

- External microphone to Internal earpiece
- External microphone to Internal handsfree speaker
- Internal microphone to External earpiece

Each audio loop sets routing from the specified input to the specified output enabling a quick in-out test. Loop path gains are fixed and they cannot be changed using Phoenix. Correct pins and signals for each test are presented in the following table.

Phoenix audio loop tests and test results

The results presented in the table apply when no accessory is connected and battery voltage is set to 3.7 V.

Earpiece, internal microphone and speaker are in place during measurement. Applying a headset accessory during measurement causes a significant drop in measured quantities.

The gain values presented in the table apply for a differential output vs. single-ended/differential input.

Loop test	Input terminal	Output terminal	Path gain [dB] (fixed)	Input voltage [mVp-p]	Differential output voltage [mVp-p]	Output DC level [V]	Output current [mA]
External Mic in External Speaker out	XMICP and GND	HSEAR R P, HSEAR R N and GND	2.9	280	390	1.25	N/A
		HSEAR P, HSEAR N and GND					
	XMICN and GND	HSEAR R P, HSEAR R N and GND					
		HSEAR P, HSEAR N and GND					
External Mic in HP Speaker out	XMICP and GND	EarP and GND	6.9	140	310	1.25	N/A
		EarN and GND					
	XMICN and GND	EarP and GND					
		EarN and GND					
External Mic in Internal Handsfree out	XMICP and GND	B1 pads	11.4	150	560	0	25 mA (calc.)
	XMICN and GND	B1 pads					
Digital Stereo Mic in External Earpiece out	B1 and B2	HSEAR R P, HSEAR R N and GND	NA	100 (dBA) Sound Pressure Level (SPL)	100	1.28	N/A
		HSEAR P, HSEAR N and GND					

Measurement data

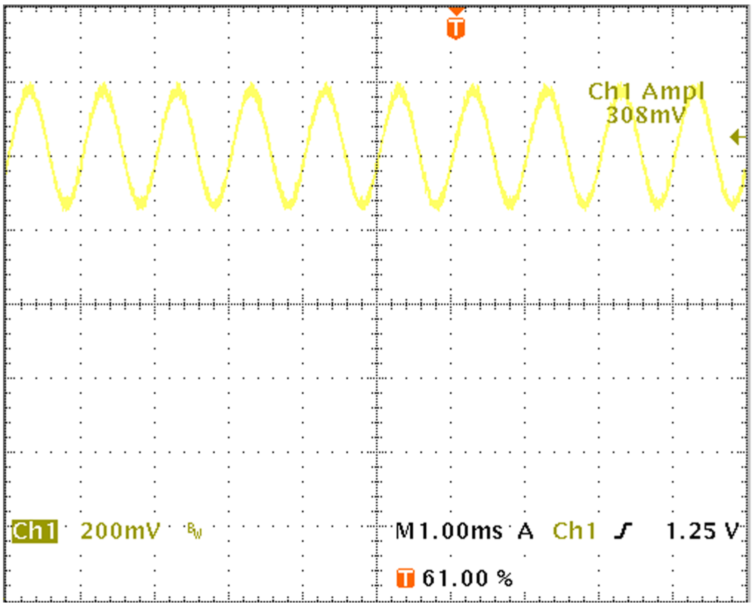
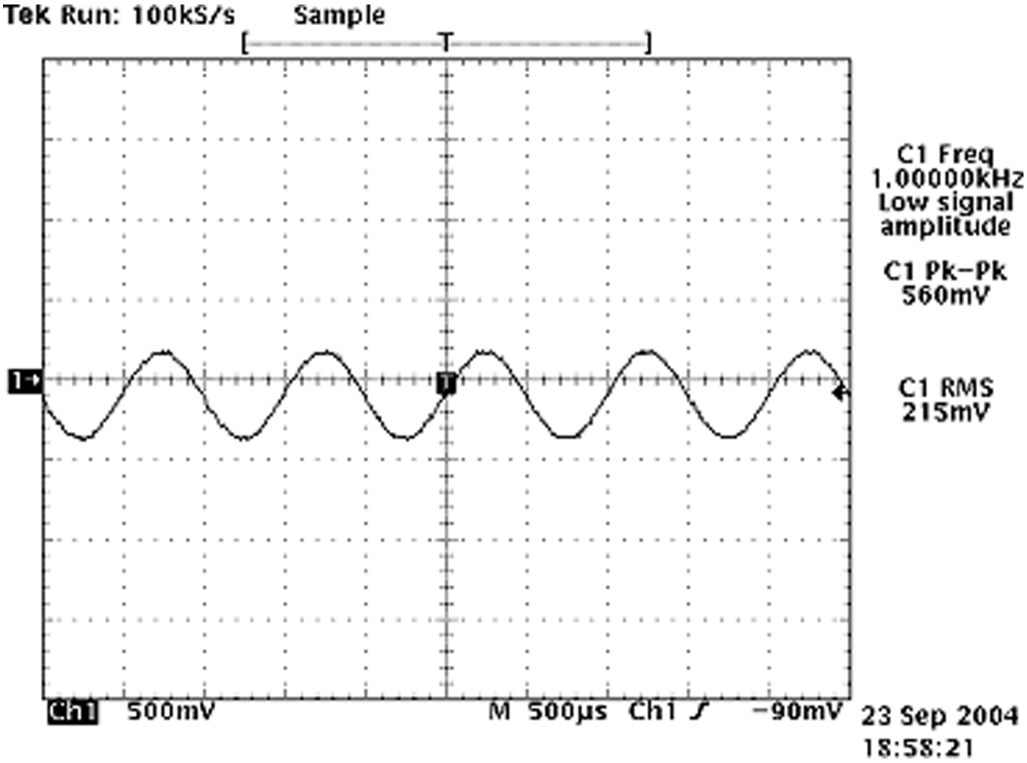

Ch1 Ampl
308mV
Ch1 200mV
M1.00ms A Ch1 1.25 V
61.00 %

Figure 12 Single-ended output waveform of the Ext_in_HP_out measurement when earpiece is connected.


Tek Run: 100kS/s Sample
C1 Freq
1.00000kHz
Low signal
amplitude
C1 Pk-Pk
560mV
C1 RMS
215mV
Ch1 500mV
M 500µs Ch1 -90mV
23 Sep 2004
18:58:21

If a special low-pass filter designed for measuring digital amplifiers is unavailable, the measurement must be performed with a current probe and the input signal frequency must be 2kHz.

Figure 13 Differential output waveform of the Ext_in_IHF_out out loop measurement when speaker is connected.

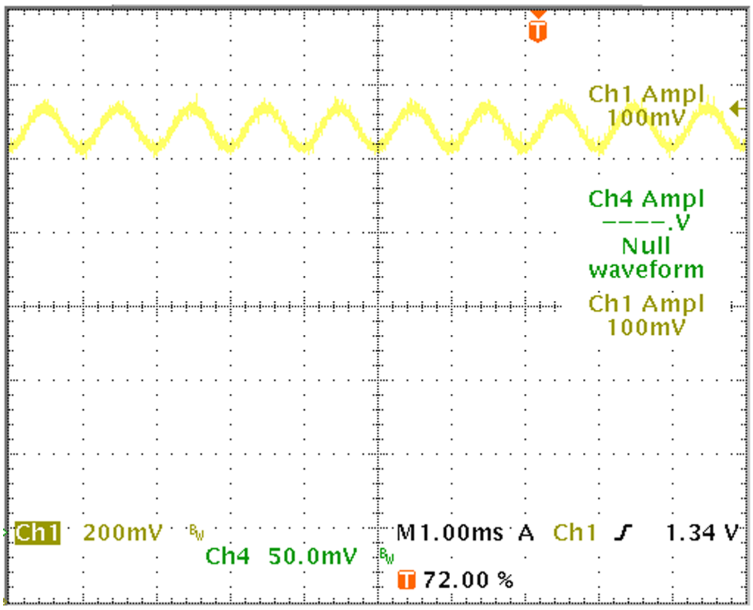
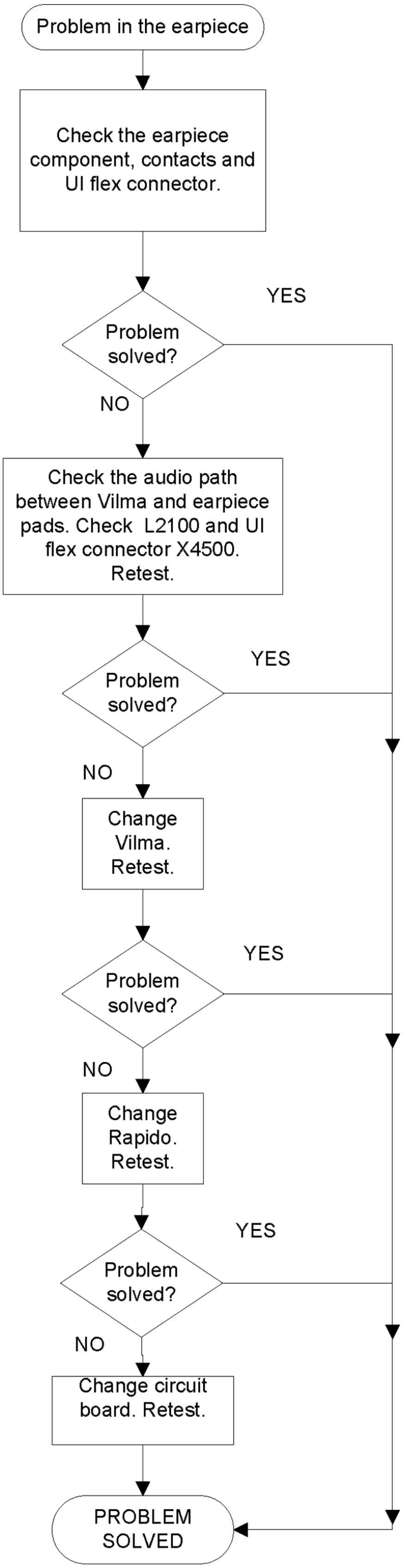


Figure 14 Single-ended output waveform of the HP_in_Ext_out loop when microphone is connected.

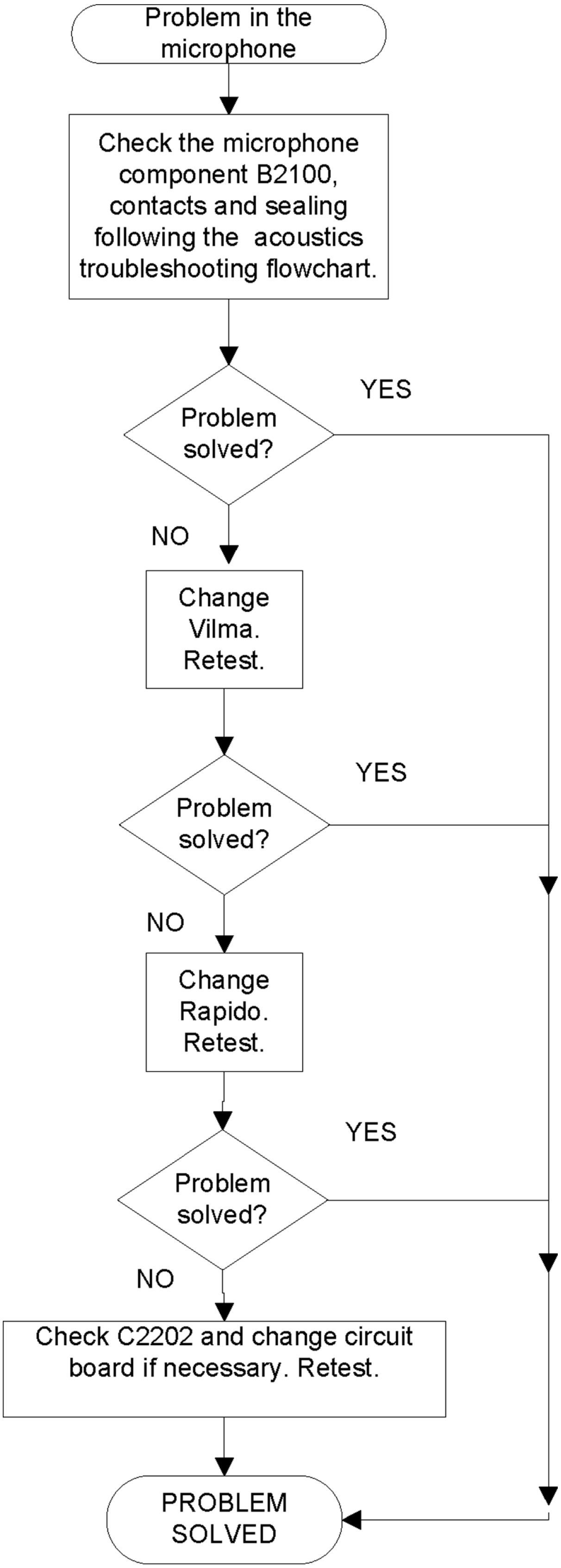
Internal earpiece troubleshooting

Troubleshooting flow


Problem in the earpiece
Check the earpiece component, contacts and UI flex connector.
Problem solved?
YES
NO
Check the audio path between Vilma and earpiece pads. Check L2100 and UI flex connector X4500. Retest.
Problem solved?
YES
NO
Change Vilma. Retest.
Problem solved?
YES
NO
Change Rapido. Retest.
Problem solved?
YES
NO
Change circuit board. Retest.
PROBLEM SOLVED

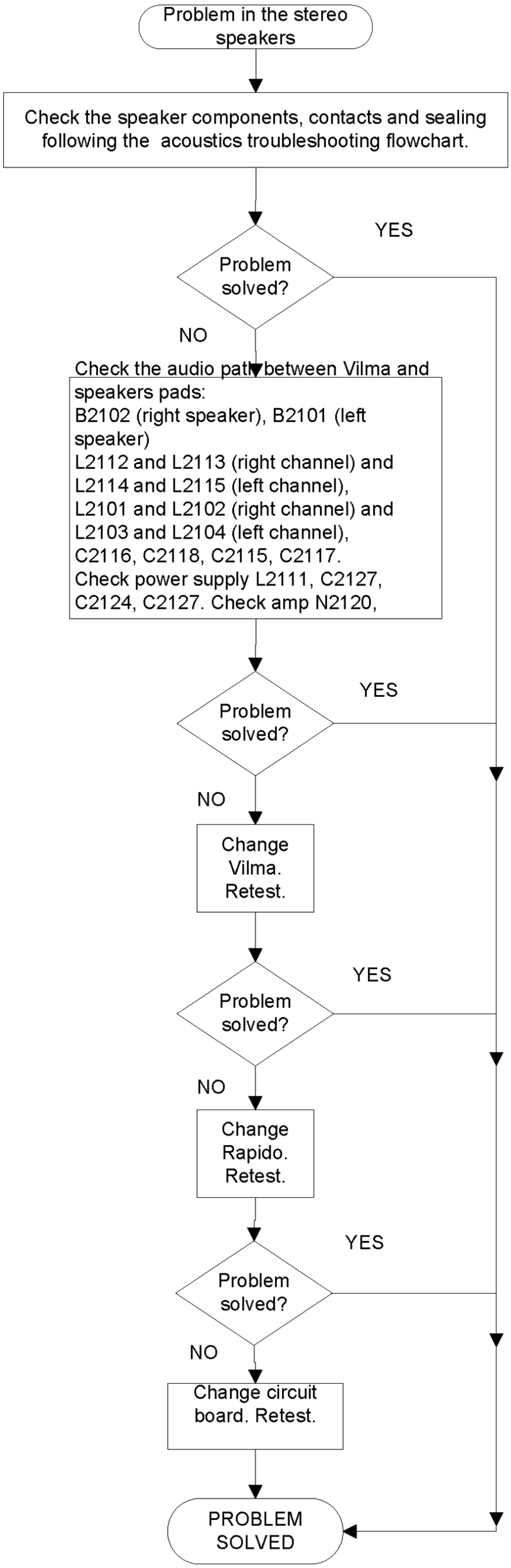
Internal digital microphone troubleshooting

Troubleshooting flow


Problem in the microphone
Check the microphone component B2100, contacts and sealing following the acoustics troubleshooting flowchart.
Problem solved?
YES
NO
Change Vilma. Retest.
Problem solved?
YES
NO
Change Rapido. Retest.
YES
Problem solved?
NO
Check C2202 and change circuit board if necessary. Retest.
PROBLEM SOLVED

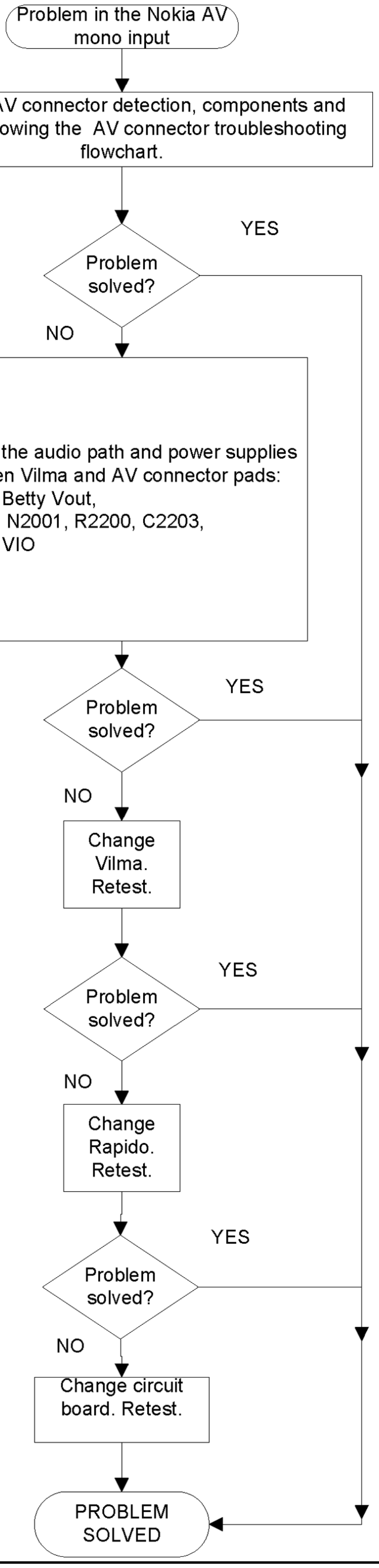
IHF troubleshooting

Troubleshooting flow


Problem in the stereo speakers
Check the speaker components, contacts and sealing following the acoustics troubleshooting flowchart.
Problem solved?
YES
NO
Check the audio path between Vilma and speakers pads:
B2102 (right speaker), B2101 (left speaker)
L2112 and L2113 (right channel) and L2114 and L2115 (left channel),
L2101 and L2102 (right channel) and L2103 and L2104 (left channel),
C2116, C2118, C2115, C2117.
Check power supply L2111, C2127, C2124, C2127. Check amp N2120,
Problem solved?
YES
NO
Change Vilma. Retest.
Problem solved?
YES
NO
Change Rapido. Retest.
Problem solved?
YES
NO
Change circuit board. Retest.
PROBLEM SOLVED

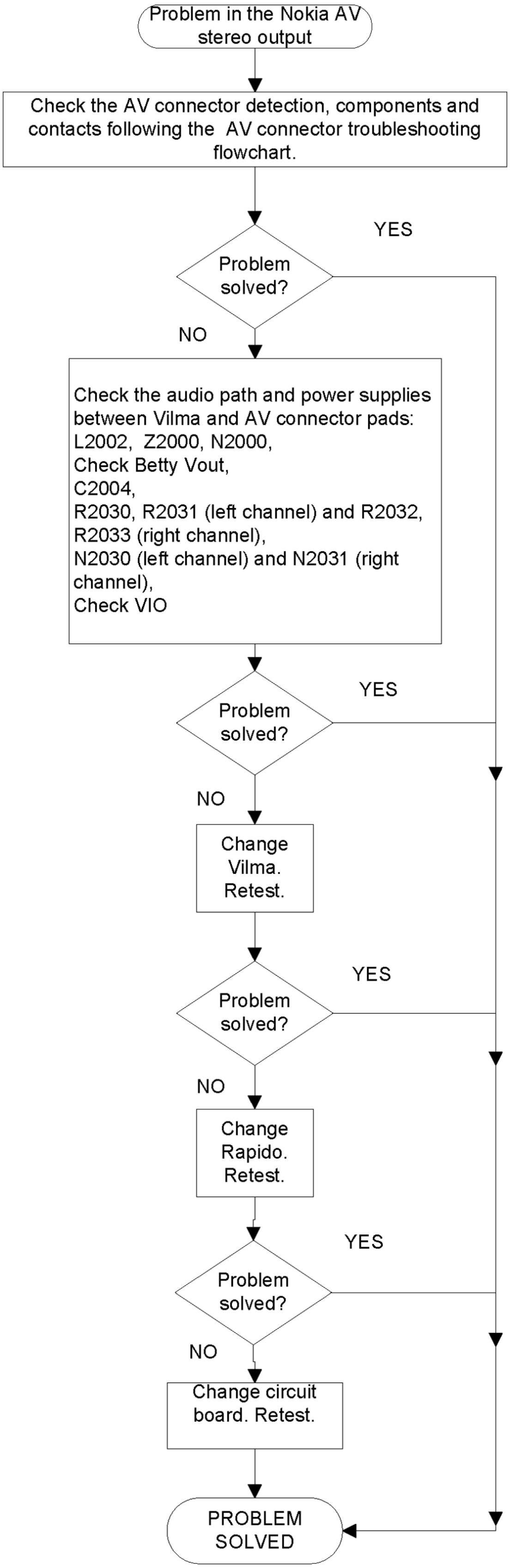
External microphone troubleshooting

Troubleshooting flow


Problem in the Nokia AV mono input
Check the AV connector detection, components and contacts following the AV connector troubleshooting flowchart.
Problem solved?
YES
NO
Check the audio path and power supplies between Vilma and AV connector pads:
Check Betty Vout,
L2001, N2001, R2200, C2203,
Check VIO
Problem solved?
YES
NO
Change Vilma. Retest.
Problem solved?
YES
NO
Change Rapido. Retest.
Problem solved?
YES
NO
Change circuit board. Retest.
PROBLEM SOLVED

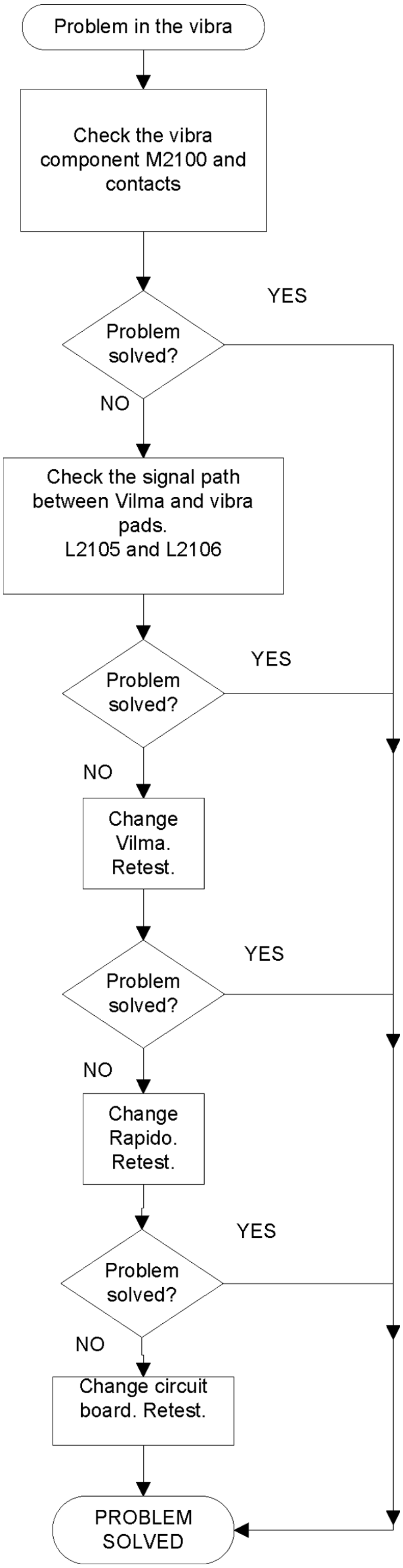
External earpiece troubleshooting

Troubleshooting flow


Problem in the Nokia AV stereo output
Check the AV connector detection, components and contacts following the AV connector troubleshooting flowchart.
YES
Problem solved?
NO
Check the audio path and power supplies between Vilma and AV connector pads:
L2002, Z2000, N2000,
Check Betty Vout,
C2004,
R2030, R2031 (left channel) and R2032, R2033 (right channel),
N2030 (left channel) and N2031 (right channel),
Check VIO
YES
Problem solved?
NO
Change Vilma. Retest.
YES
Problem solved?
NO
Change Rapido. Retest.
YES
Problem solved?
NO
Change circuit board. Retest.
PROBLEM SOLVED

Vibra troubleshooting

Troubleshooting flow


Problem in the vibra
Check the vibra component M2100 and contacts
Problem solved?
YES
NO
Check the signal path between Vilma and vibra pads.
L2105 and L2106
Problem solved?
YES
NO
Change Vilma. Retest.
Problem solved?
YES
NO
Change Rapido. Retest.
Problem solved?
YES
NO
Change circuit board. Retest.
PROBLEM SOLVED

Baseband manual tuning guide

Energy management calibration

Prerequisites

Energy Management (EM) calibration is performed to calibrate the setting (gain and offset) of AD converters in several channels (that is, **battery voltage**, **BSI**, **battery current**) to get an accurate AD conversion result.

Hardware setup:

- An external power supply is needed.
- Supply 12V DC from an external power supply to CU-4 to power up the phone.
- The phone must be connected to a CU-4 control unit with a product-specific flash adapter.

Steps

1. Place the phone to the docking station adapter (CU-4 is connected to the adapter).
2. Start *Phoenix* service software.
3. Choose **File**→ **Scan Product.**
4. Choose **Tuning**→**Energy Management Calibration.**
5. To show the current values in the phone memory, click **Read**, and check that communication between the phone and CU-4 works.
6. Check that the **CU-4 used** check box is checked.
7. Select the item(s) to be calibrated.

   Note: ADC calibration has to be performed before other item(s). However, if all calibrations are selected at the same time, there is no need to perform the ADC calibration first.
8. Click **Calibrate**.

   The calibration of the selected item(s) is carried out automatically.

   The candidates for the new calibration values are shown in the *Calculated values* column. If the new calibration values seem to be acceptable (please refer to the following "Calibration value limits" table), click **Write** to store the new calibration values to the phone permanent memory.

Table 8 Calibration value limits

Parameter	Low	High
ADC Offset	-14	14
ADC Gain	13000	13350
BSI Gain	1100	1300
VBAT Offset	2450	2570
VBAT Gain	21000	21900
IBAT Gain	9000	11000

9. Click **Read**, and confirm that the new calibration values are stored in the phone memory correctly. If the values are not stored to the phone memory, click **Write** and/or repeat the procedure again.
10. To end the procedure, close the *Energy Management Calibration* window.

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4 — RF troubleshooting

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General RF troubleshooting

Introduction to RF troubleshooting

Most RF semiconductors are static discharge sensitive

ESD protection must be applied during repair (ground straps and ESD soldering irons).

Pre-baking

These parts are moisture sensitive and must be pre-baked prior to soldering:

- RF IC N7505
- Front End Module (FEM) N7520
- WCDMA PA N7540

Discrete components

In addition to the key-components, there are a number of discrete components (resistors, inductors and capacitors) for which troubleshooting is done mainly by *visual inspection*.

Capacitors: check for short circuits.

Resistors: check value with an ohm meter.

Note: In-circuit measurements should be evaluated carefully

Measuring equipment

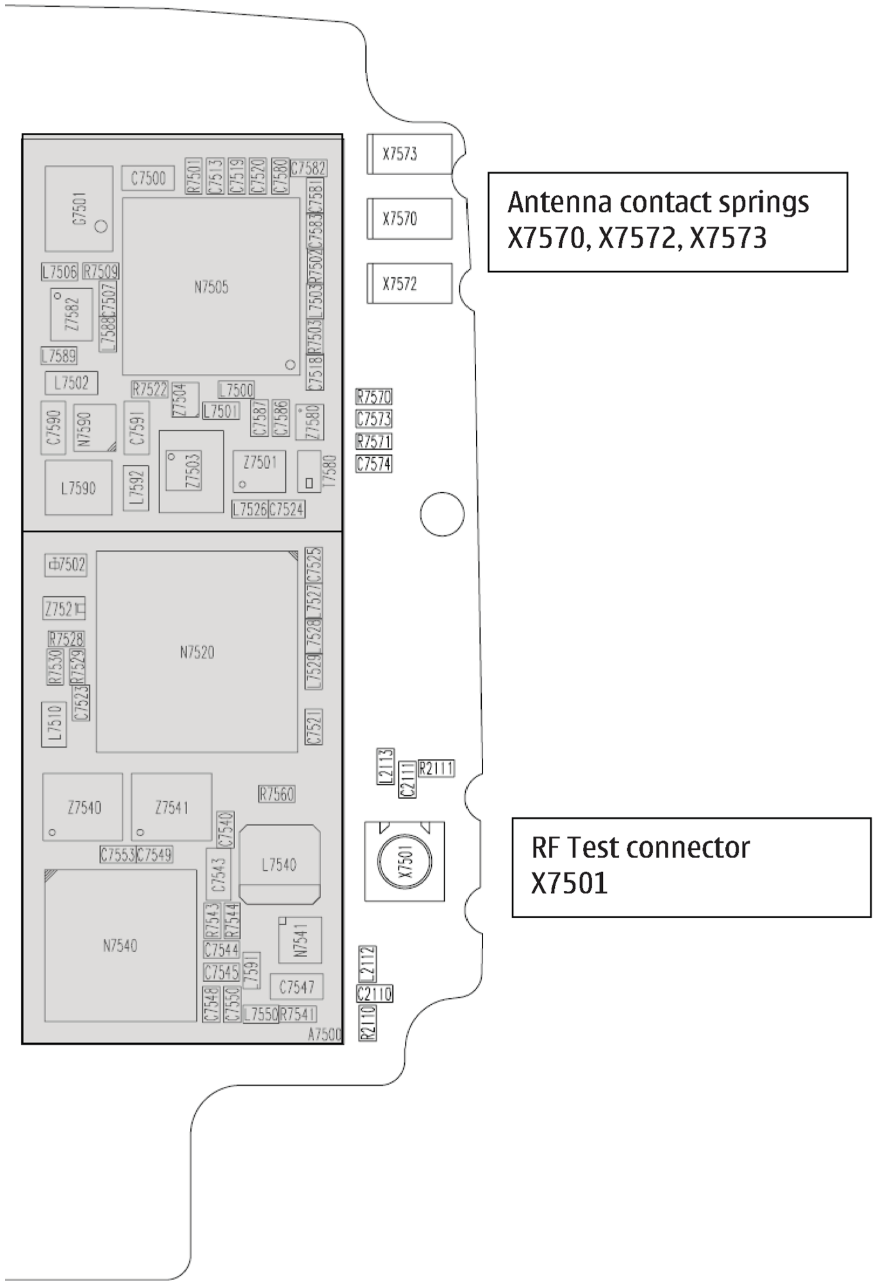
All measurements should be done using:

- An oscilloscope for low frequency and DC measurements. Recommended probe: 10:1, 10Mohm//8pF.
- A radio communication tester including RF generator and spectrum analyser, for example Rohde & Schwarz CMU200. (Alternatively a spectrum analyser and an RF generator can be used. Some tests in this guide are not possible to perform if this solution is chosen).

Note: A mobile phone WCDMA transmitter should never be tested with full TX power (only it possible to perform the measurements in a good RF-shielded room). Even low power WCDMA transmitters may disturb nearby WCDMA networks and cause problems to 3G cellular phone communication in a wide area.

Note: All measurements with an RF coupler should be performed in an RF-shielded environment because nearby base stations can disturb sensitive receiver measurements. If there is no possibility to use RF shielded environment, testing at frequencies of nearby base stations should be avoided.

RF key components


X7573
X7570
X7572
C7501
C7500
R7501
C7513
C7519
C7520
C7580
C7582
N7505
L7506
R7509
Z7582
L7507
L7588
L7589
L7502
R7522
Z7504
L7500
L7501
C7590
N7590
C7591
Z7503
Z7501
Z7580
L7590
L7592
L7526
C7524
R7570
C7573
R7571
C7574
C7502
Z7521
R7528
R7530
R7529
C7523
L7510
N7520
C7525
L7527
L7528
L7529
C7521
L2113
C2111
R2111
Z7540
Z7541
R7560
C7540
C7553
C7549
C7543
L7540
X7501
N7540
R7543
R7544
N7541
C7544
C7545
C7547
C7548
C7550
L7550
R7541
A7500
L2112
C2110
R2110

Antenna contact springs
X7570, X7572, X7573

RF Test connector
X7501

Auto tuning for BB5.0

This phone can be tuned automatically.

Autotune is designed to align the phone's RF part easier and faster. It performs calibrations, tunings and measurements of RX and TX. The results are displayed and logged in a result file, if initiated.

Hardware set up

Hardware requirements for auto tuning:

- PC (Windows 2000/XP) with GPIB card

- Power supply
- Product specific module jig
- Cables: XRF-1 (RF cable), USB cable, GBIP cable and DAU-9S
- Signal analyser (TX), signal generator (RX) and RF-splitter *or* one device including all.

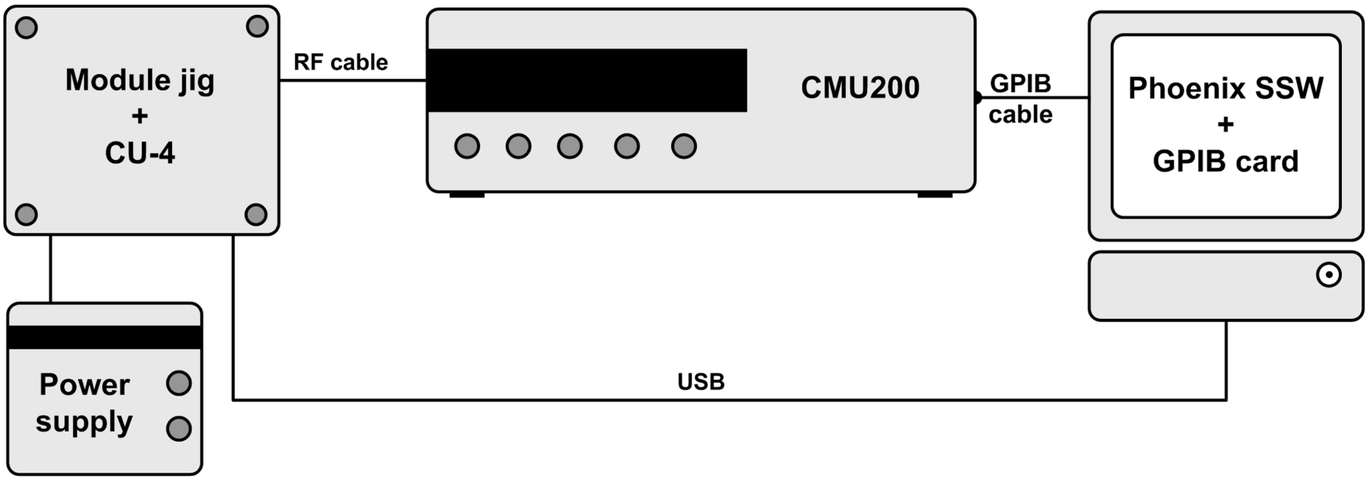


Figure 15 Auto tuning concept with CMU200

Phoenix preparations

Install the phone specific data package, for example *RA-6_dp_1.78_sw_sh3.26.exe*. This defines phone specific settings..

Auto tuning procedure

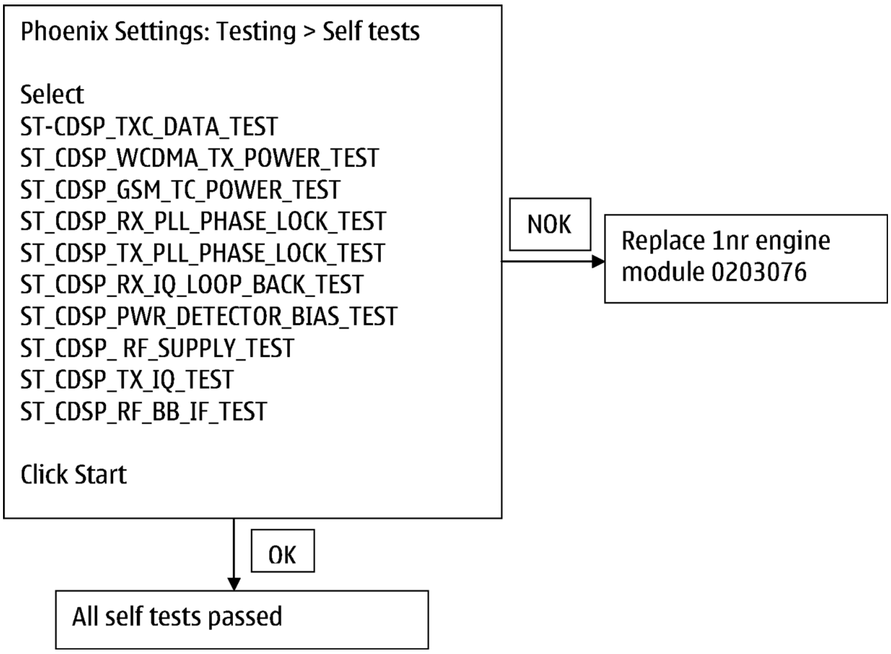
1. Make sure the phone (in the jig) is connected to the equipment. Else, some menus will not be shown in Phoenix.
2. To go to autotune, select *Tuning (Alt-U)* > *Auto-Tune (Alt-A)* from the menu.
3. Start autotuning, clicking the *Tune* button.

Antenna line component changing

1. Check the RF test connector (X7501)
2. Check the antenna contact springs (X7570, X7572 and X7573)

Self test troubleshooting

Troubleshooting flow


Phoenix Settings: Testing > Self tests
Select
ST-CDSP_TXC_DATA_TEST
ST_CDSP_WCDMA_TX_POWER_TEST
ST_CDSP_GSM_TC_POWER_TEST
ST_CDSP_RX_PLL_PHASE_LOCK_TEST
ST_CDSP_TX_PLL_PHASE_LOCK_TEST
ST_CDSP_RX_IQ_LOOP_BACK_TEST
ST_CDSP_PWR_DETECTOR_BIAS_TEST
ST_CDSP_ RF_SUPPLY_TEST
ST_CDSP_TX_IQ_TEST
ST_CDSP_RF_BB_IF_TEST
Click Start
NOK
Replace 1nr engine module 0203076
OK
All self tests passed

Receiver troubleshooting

Introduction to receiver (RX) troubleshooting

RX can be tested by making a phone call or in local mode. For the local mode testing, use Phoenix service software.

The main RX troubleshooting measurement is RSSI reading. This test measures the signal strength of the received signal. For GSM RSSI measurements, see *GSM RX chain activation for manual measurements/GSM RSSI measurement*. For a similar test in WCDMA mode, see *WCDMA RSSI measurement*.

GSM RX chain activation for manual measurements/GSM RSSI measurement

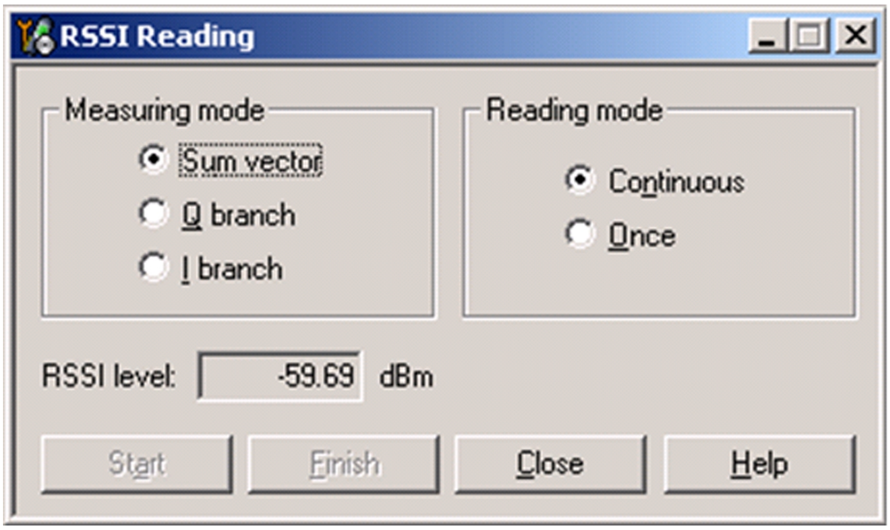
Prerequisites

Make the following settings in Phoenix service software:

Setting	GSM900	GSM1800	GSM1900
Phoenix Channel	37	700	661
Signal generator to antenna connector	942.46771MHz (67.71kHz offset) at -60dBm	1842.86771MHz (67.71kHz offset) at -60dBm	1960.046771MHz (67.71kHz offset) at -60dBm

Steps

1. Set the phone to local mode.
2. Activate RSSI reading in Phoenix (**Testing→GSM→RSSI reading**)



Measuring mode
● Sum vector
○ Q branch
○ I branch

Reading mode
● Continuous
○ Once

RSSI level: -59.69 dBm

Results

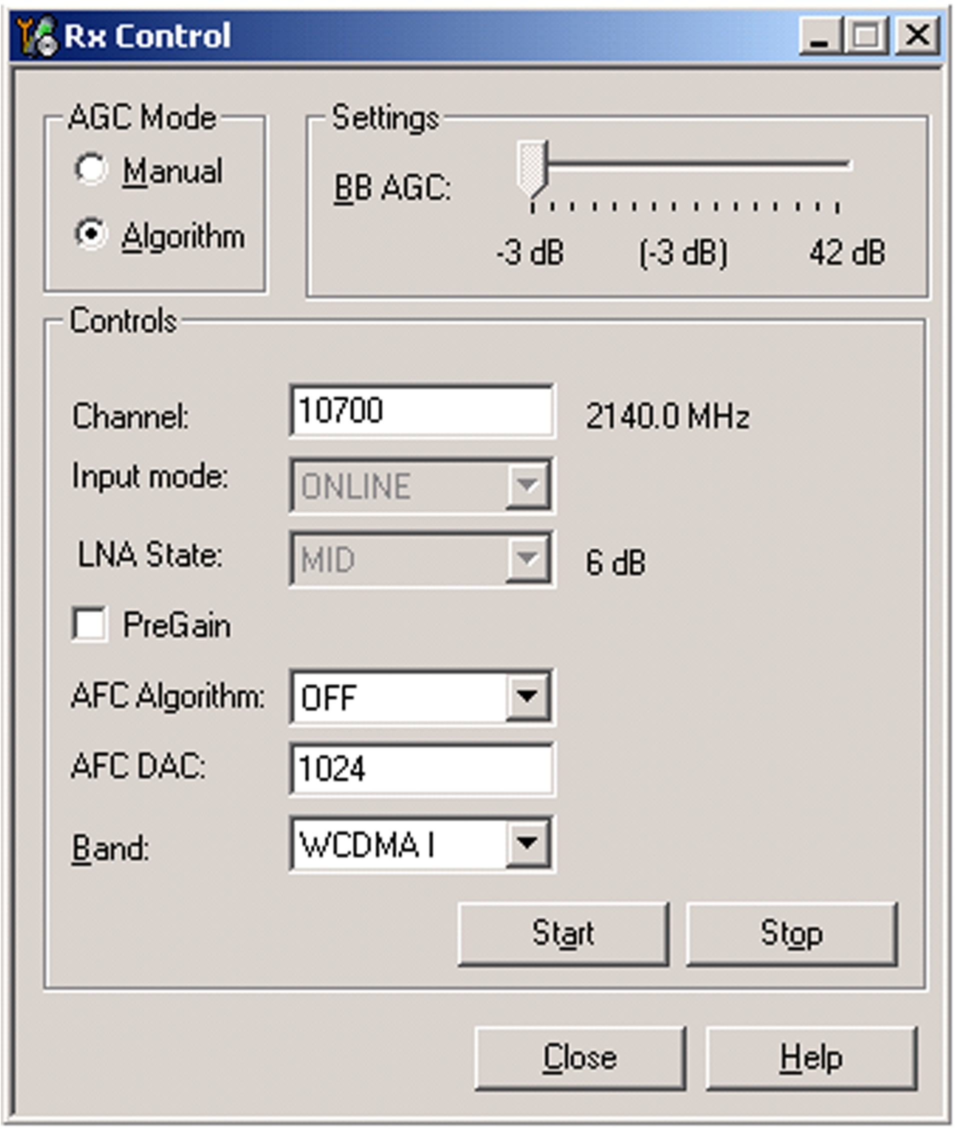
The reading should reflect the level of the signal generator (-losses) +/- 5 dB.

When varying the level in the range -30 to -102 dBm the reading should then follow within +/-5 dB.

WCDMA RX chain activation for manual measurement

Steps

1. Via Phoenix Testing menu, choose **WCDMA/RX Control**.
2. In the RX control window, make the following settings:



○ Manual
● Algorithm

BB AGC: -3 dB (-3 dB) 42 dB

Channel: 10700 2140.0 MHz

Input mode: ONLINE

LNA State: MID 6 dB

☐ PreGain

AFC Algorithm: OFF

AFC DAC: 1024

Band: WCDMA I

3. Click **Start** to activate the settings.

   If the settings are changed later on (for example, change of channel) you have to click **Stop** and **Start** again.

   Note: Clicking **Stop** also disables TX control if it was active.

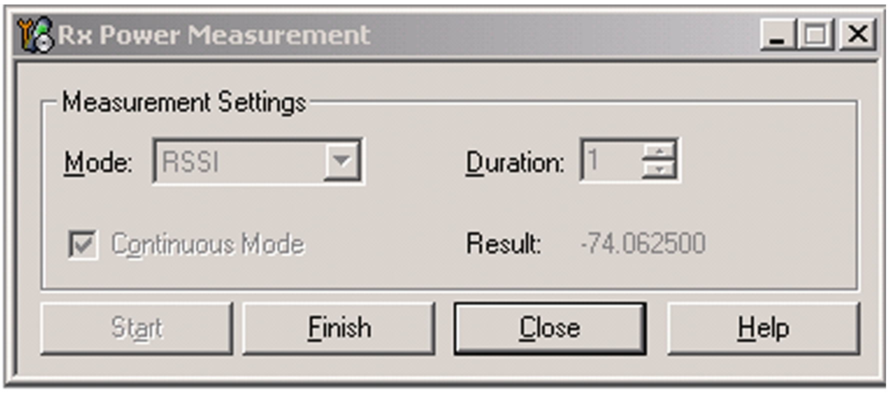
WCDMA RSSI measurement

Prerequisites

WCDMA RX must be activated before RSSI can be measured. For instructions, please refer to WCDMA RX chain activation (page 4–9).

Steps

1. From the Phoenix testing menu, select **WCDMA→RX Power measurement**
2. In the RX Power measurement window, select:
   - Mode: RSSI
   - Continuous mode



Mode: RSSI

Duration: 1

☑ Continuous Mode

Result: -74.062500

3. Click **Start** to perform the measurement.

Transmitter troubleshooting

General instructions for transmitter (TX) troubleshooting

Please note the following before performing transmitter tests:

- TX troubleshooting requires TX operation.
- Do not transmit on frequencies that are in use!
- The transmitter can be controlled in local mode for diagnostic purposes.
- The most useful Phoenix tool for GSM transmitter testing is “RF Controls”; in WCDMA transmitter testing the best tool is “TX Control”.
- Remember that re-tuning is not a fix! Phones are tuned correctly in production

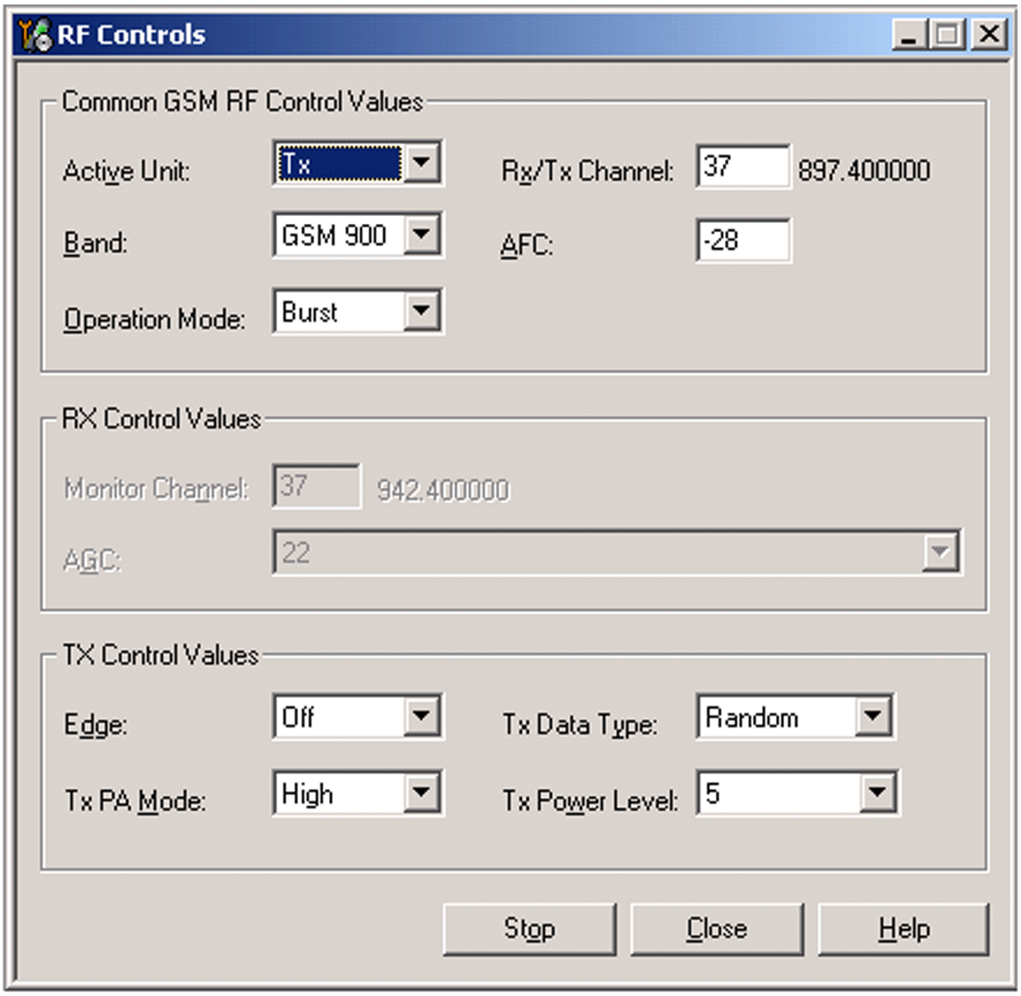
> **Note:** Never activate the GSM or WCDMA transmitter without a proper antenna load. Always connect a 50 Ω load to the RF connector (antenna, RF-measurement equipment or at least a 2 W dummy load); otherwise the GSM or WCDMA Power amplifier (PA) may be damaged.

GSM transmitter troubleshooting

Steps

1. Set the phone to local mode.
2. Activate RF controls in Phoenix (**Testing→GSM→Rf Controls**).

   Make settings as shown in the picture:



Common GSM RF Control Values

Active Unit: Tx
Rx/Tx Channel: 37 897.400000
Band: GSM 900
AFC: -28
Operation Mode: Burst

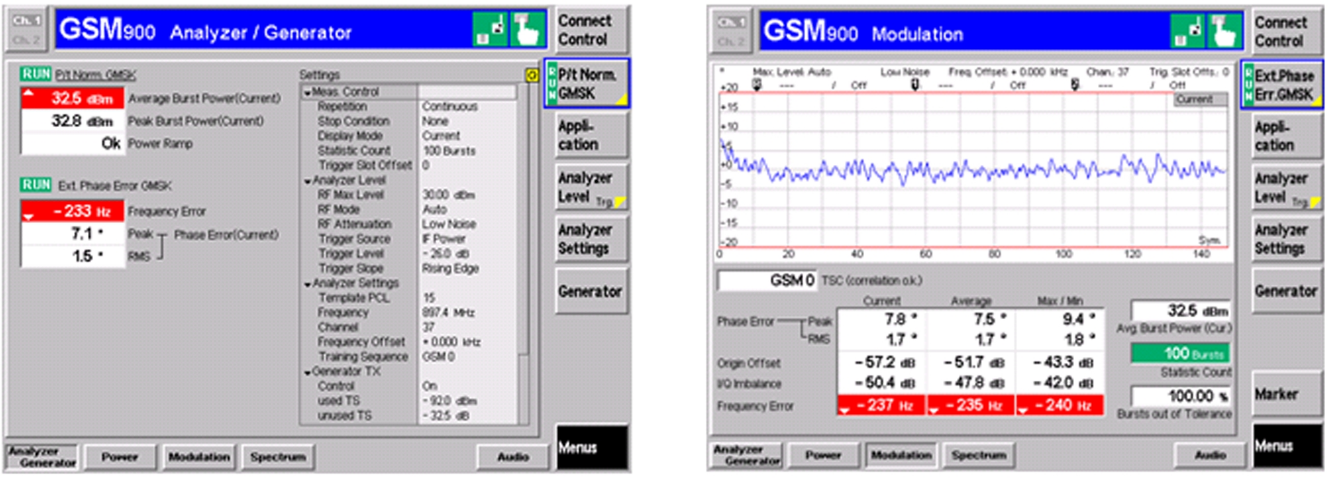
RX Control Values

Monitor Channel: 37 942.400000
AGC: 22

TX Control Values

Edge: Off
Tx Data Type: Random
Tx PA Mode: High
Tx Power Level: 5

3. Check the basic TX parameters (i.e. power, phase error, modulation and switching spectrum), using a communication analyser (for example CMU200).



Analyser settings

GSM900 Analyzer / Generator

RUN P/t Norm. GMSK

32.5 dBm	Average Burst Power(Current)
32.8 dBm	Peak Burst Power(Current)
Ok	Power Ramp

RUN Ext. Phase Error GMSK

-233 Hz	Frequency Error
7.1 °	Peak — Phase Error(Current)
1.5 °	RMS

Settings

Meas. Control	
Repetition	Continuous
Stop Condition	None
Display Mode	Current
Statistic Count	100 Bursts
Trigger Slot Offset	0
Analyzer Level	
RF Max Level	30.00 dBm
RF Mode	Auto
RF Attenuation	Low Noise
Trigger Source	IF Power
Trigger Level	-26.0 dB
Trigger Slope	Rising Edge
Analyzer Settings	
Template PCL	15
Frequency	897.4 MHz
Channel	37
Frequency Offset	+0.000 kHz
Training Sequence	GSM 0
Generator TX	
Control	On
used TS	-92.0 dBm
unused TS	-32.5 dB

Phase error

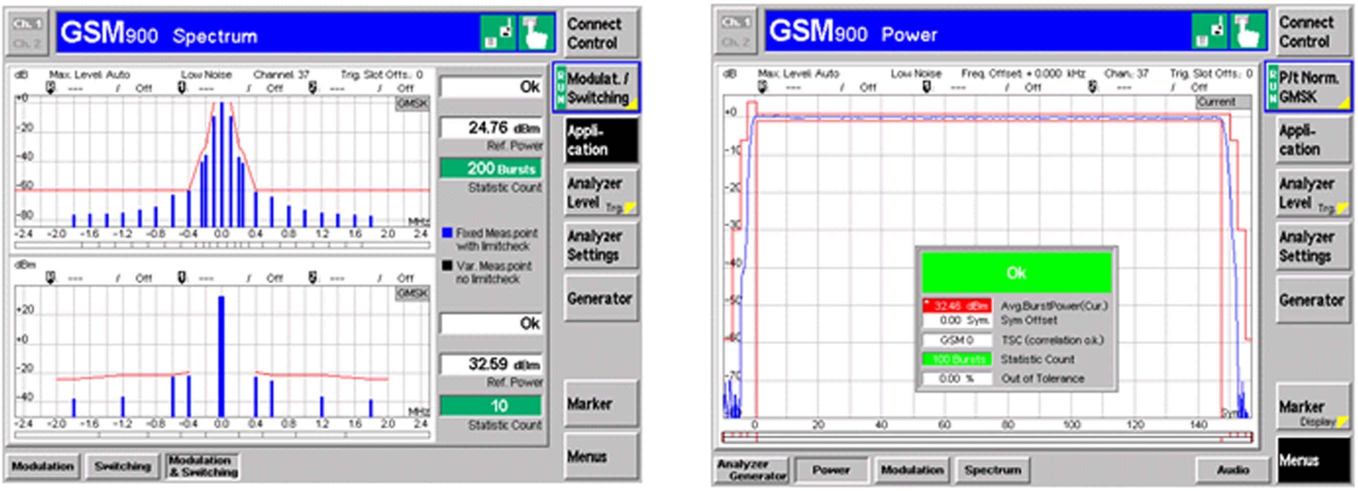
GSM900 Modulation

GSM 0 TSC (correlation o.k.)

		Current	Average	Max / Min
Phase Error	Peak	7.8 °	7.5 °	9.4 °
	RMS	1.7 °	1.7 °	1.8 °
Origin Offset		-57.2 dB	-51.7 dB	-43.3 dB
I/Q Imbalance		-50.4 dB	-47.8 dB	-42.0 dB
Frequency Error		-237 Hz	-235 Hz	-240 Hz

32.5 dBm Avg. Burst Power (Cur.)
100 Bursts Statistic Count
100.00 % Bursts out of Tolerance

Connect Control
P/t Norm. GMSK
Ext. Phase Err. GMSK
Appli-cation
Analyzer Level
Analyzer Settings
Generator
Marker
Menus
Analyzer Generator
Power
Modulation
Spectrum
Audio
Max. Level Auto
Low Noise
Freq. Offset +0.000 kHz
Chan.: 37
Trig. Slot Offs.: 0
Sym.



Modulation/Switching spectrum

GSM900 Spectrum

Ok
24.76 dBm Ref. Power
200 Bursts Statistic Count
Ok
32.59 dBm Ref. Power
10 Statistic Count

Power/Burst

GSM900 Power

Ok

32.46 dBm	AvgBurstPower(Cur.)
0.00 Sym.	Sym. Offset
GSM 0	TSC (correlation o.k.)
100 Bursts	Statistic Count
0.00 %	Out of Tolerance

Connect Control
Modulat. / Switching
P/t Norm. GMSK
Appli-cation
Analyzer Level
Analyzer Settings
Generator
Marker
Menus
Modulation
Switching
Modulation & Switching
Analyzer Generator
Power
Spectrum
Audio
Fixed Meas.point with limitcheck
Var. Meas.point no limitcheck
Channel 37
MHz
dBm
dB
Sym.

Figure 16 Typical readings

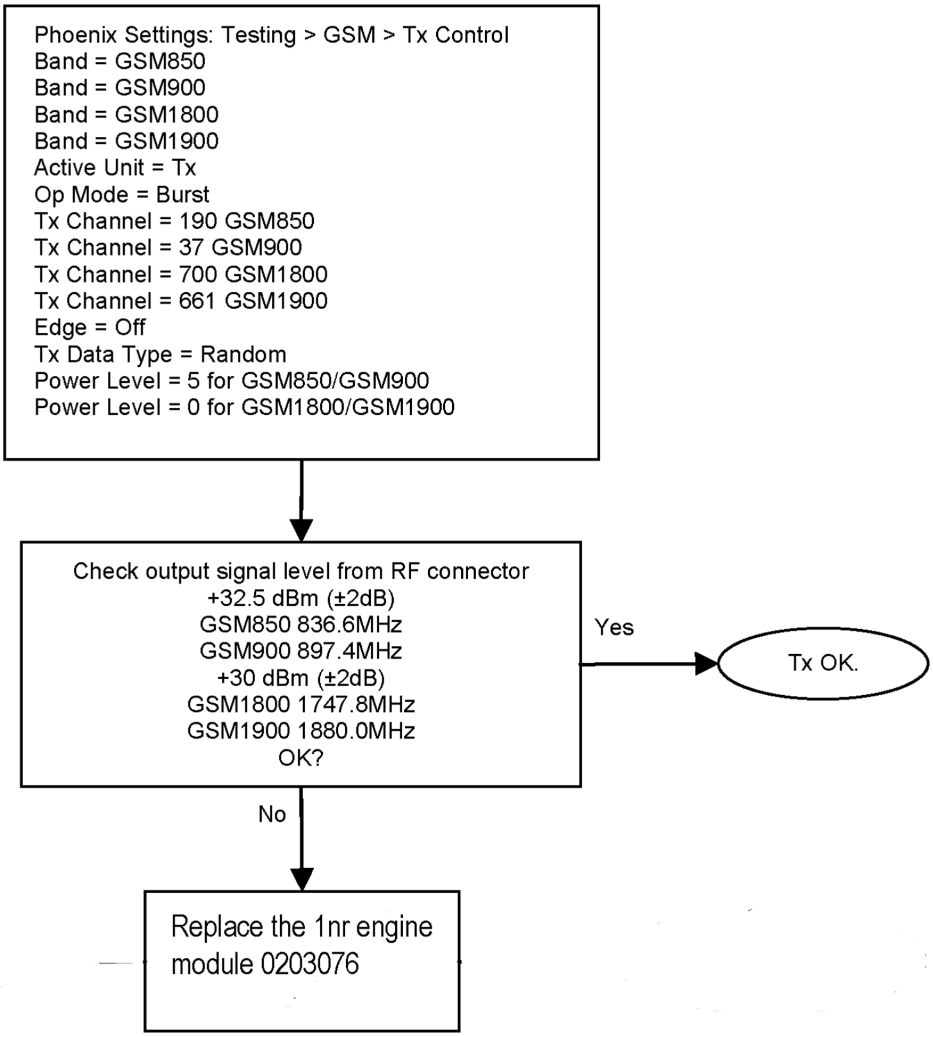
4. Change power level (RF controls) and make sure the power reading follows accordingly.

Next actions

If you want to troubleshoot the other bands, change band with RF controls and set the communication analyser accordingly.

GSM transmitter troubleshooting flowchart

Troubleshooting flow



Phoenix Settings: Testing > GSM > Tx Control
Band = GSM850
Band = GSM900
Band = GSM1800
Band = GSM1900
Active Unit = Tx
Op Mode = Burst
Tx Channel = 190 GSM850
Tx Channel = 37 GSM900
Tx Channel = 700 GSM1800
Tx Channel = 661 GSM1900
Edge = Off
Tx Data Type = Random
Power Level = 5 for GSM850/GSM900
Power Level = 0 for GSM1800/GSM1900

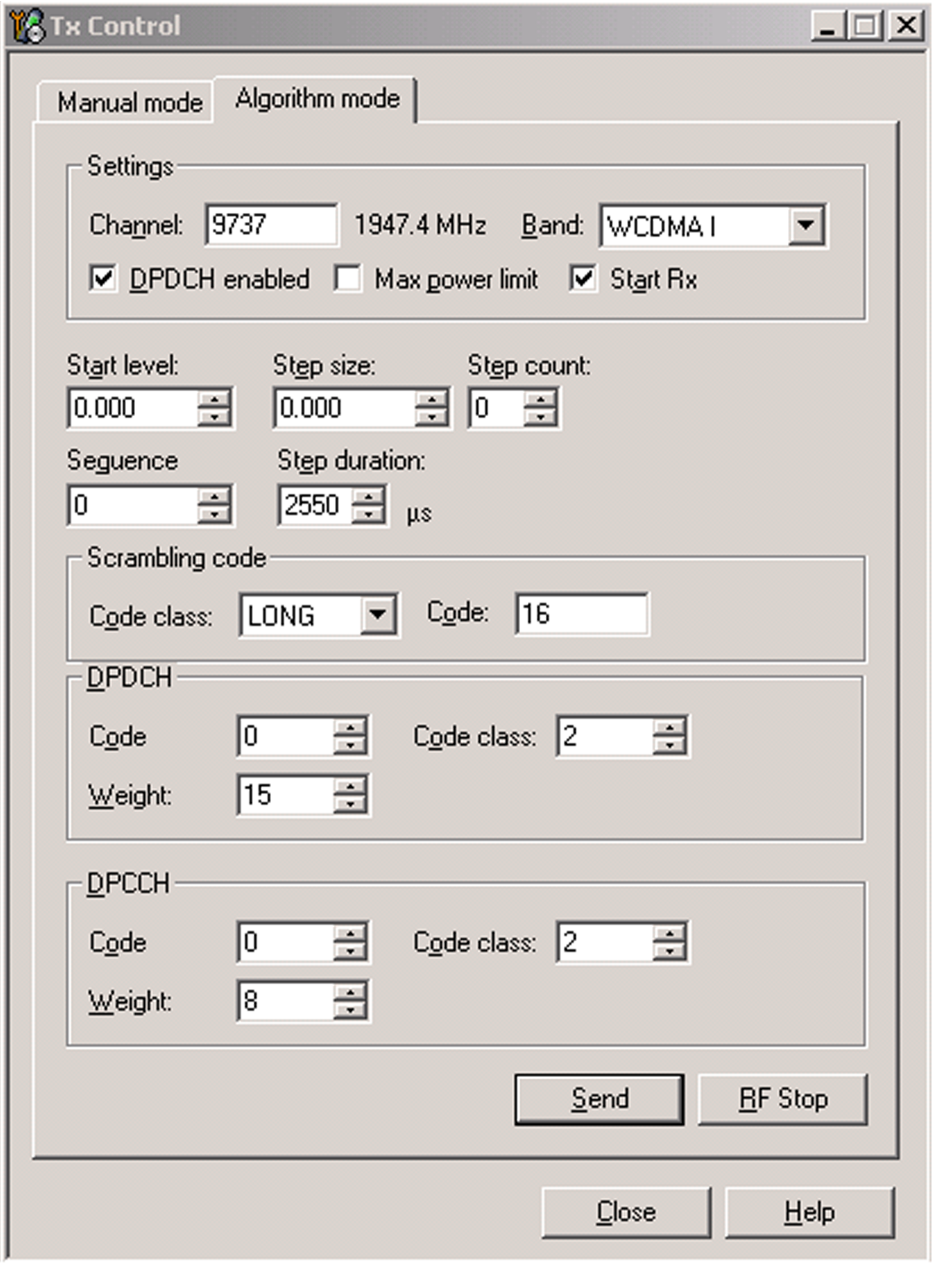
Check output signal level from RF connector
+32.5 dBm (±2dB)
GSM850 836.6MHz
GSM900 897.4MHz
+30 dBm (±2dB)
GSM1800 1747.8MHz
GSM1900 1880.0MHz
OK?

Replace the 1nr engine module 0203076

WCDMA transmitter troubleshooting

Steps

1. Set the phone to local mode.
2. In Phoenix, select **Testing→WCDMA→TX control** .
3. In the TX control window, make settings like in the picture:


Tx Control
Manual mode
Algorithm mode
Send
RF Stop
Close
Help

Settings
Channel: 9737 1947.4 MHz Band: WCDMA I
☑ DPDCH enabled ☐ Max power limit ☑ Start Rx

Start level: 0.000
Step size: 0.000
Step count: 0
Sequence 0
Step duration: 2550 µs

Scrambling code
Code class: LONG
Code: 16

DPDCH
Code 0
Code class: 2
Weight: 15

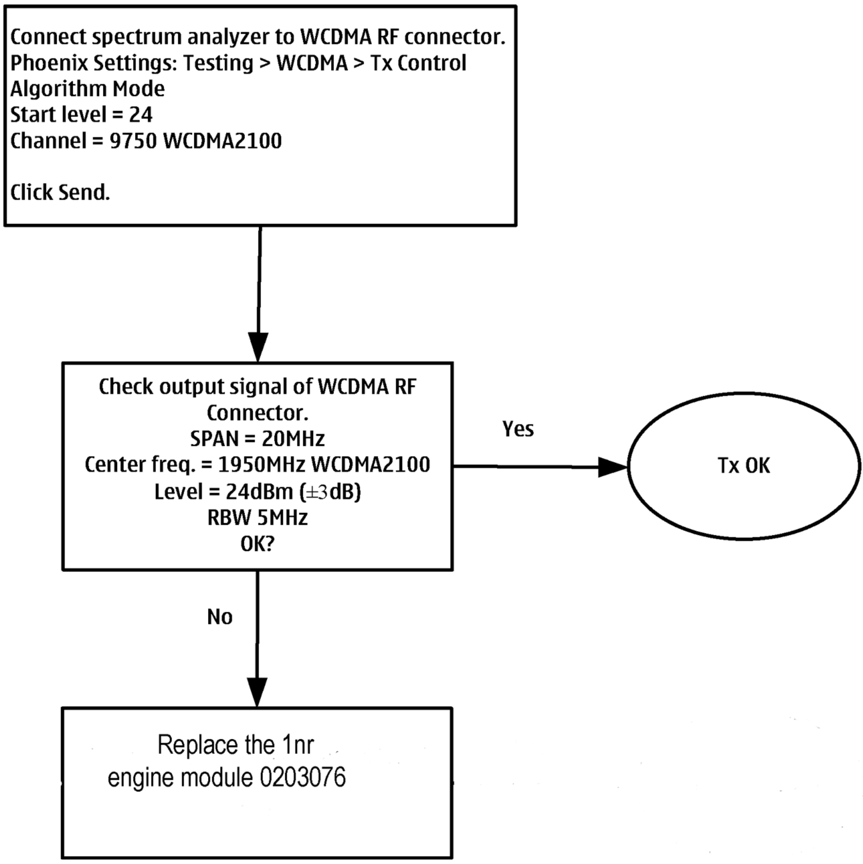
DPCCH
Code 0
Code class: 2
Weight: 8

4. Click **Send** to enable the settings and activate TX.

   If settings are changed (eg. new channel), you have to click **RF Stop** and **Send** again.

WCDMA troubleshooting

Troubleshooting flow



Connect spectrum analyzer to WCDMA RF connector.
Phoenix Settings: Testing > WCDMA > Tx Control
Algorithm Mode
Start level = 24
Channel = 9750 WCDMA2100

Click Send.

Check output signal of WCDMA RF Connector.
SPAN = 20MHz
Center freq. = 1950MHz WCDMA2100
Level = 24dBm (±3dB)
RBW 5MHz
OK?

Replace the 1nr engine module 0203076

5 — Camera Module Troubleshooting

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Camera module troubleshooting

Introduction to camera module troubleshooting

Background, tools and terminology

Faults or complaints in camera operation can be roughly categorised into three subgroups:

1. Camera is not functional at all; no image can be taken.
2. Images can be taken but there is nothing recognizable in them.
3. Images can be taken and they are recognizable but for some reason the quality of images is seriously degraded, or customer complains about image quality.

Image quality is very hard to measure quantitatively, and even comparative measurements are difficult (comparing two images) to do, if the difference is small. Especially if the user is not satisfied with his/her device's image quality, and tells, for example, that the images are not sharp, it is fairly difficult to accurately test the device and get an exact figure which would tell whether the device is functioning properly.

Often subjective evaluation has to be used for finding out if a certain property of the camera is acceptable or not. Some training or experience of a correctly operating reference device may be needed in order to detect what actually is wrong, or is there anything wrong at all.

It is easy for the user to take bad images in bad conditions. Therefore the camera operation has to be checked always in constant conditions (lighting, temperature) or by using a second, known-to-be good device as reference. Experience helps significantly in analysing image quality.

Terms

Autofocus	Camera module contains lens movement mechanics for focus adjustment. Autofocus enables camera to take sharp images of objects positioned between 10cm to infinity. During AF the viewfinder image will be momentarily blurred as the camera searches for the right focus setting.
Digital zoom	Digital zoom is done by first cropping the image by the zoom ratio and then upscaling it to the output resolution. This will decrease the image quality especially with high zoom ratios.
Dynamic range	Camera's ability to capture details in dark and bright areas of the scene simultaneously.
Exposure time	Camera modules use silicon sensor to collect light and for forming an image. The imaging process roughly corresponds to traditional film photography, in which exposure time means the time during which the film is exposed to light coming through optics. Increasing the time will allow for more light hitting the film and thus results in brighter image. The operation principle is exactly the same with silicon sensor, but the shutter functionality is handled electronically i.e. there is no mechanical moving parts like in film cameras.
Flicker	Phenomenon, which is caused by pulsating in scene lighting, typically appearing as wide horizontal stripes in an image.
ND-filter	Neutral density filter is a filter which is used in very bright conditions to reduce the amount of light hitting the sensor. The filter is built into the camera module and applied automatically when needed.
Noise	Variation of response between pixels with same level of input illumination.

Resolution	Usually the amount of pixels in the camera sensor. In some occasions the term resolution is used for describing the sharpness of the images.
Sensitivity	Camera module's sensitivity to light. In equivalent illumination conditions, a less sensitive camera needs a longer exposure time to gather enough light in forming a good image. Analogous to ISO speed in photographic film.
Sharpness	Good quality images are 'sharp' or 'crisp', meaning that image details are well visible in the picture. However, certain issues, such as non-idealities in optics, cause image blurring, making objects in picture to appear 'soft'. Each camera type typically has its own level of performance.
Shutter	The electronic shutter is used when short exposure times are needed and in video. When the mechanical shutter is used a black sheet will cover the lens after the exposure.

The effect of image taking conditions on image quality

There are some factors, which may cause poor image quality, if not taken into account by the end user when shooting images, and thus may result in complaints. The items listed are normal to camera operation and are not a reason for changing the camera module.

Autofocus

When the camera is focusing a lens is moved inside the module to give the sharpest possible image. This camera module is specified to operate satisfactorily from 10 cm to infinite distance of scene objects. Trying to photograph objects closer than 10 cm is likely to result in a blurred out of focus image. The lack of sharpness is first visible in full resolution images. Images taken very close to the subject, a limited depth of focus will be visible, that is the upper or lower parts of the image may be out of focus. This is normal; do not change the camera module.

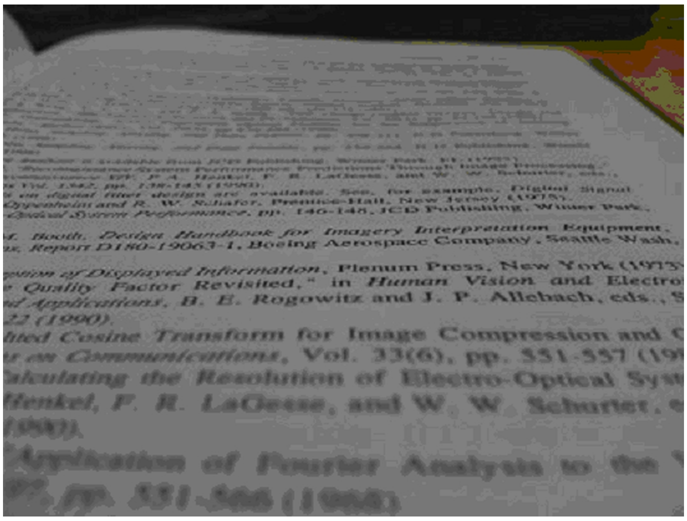


Figure 17 Only center part of image is in focus due to limited depth of focus

The amount of light available

In dim conditions camera runs out of sensitivity. The exposure time is long (especially in the night mode) and the risk of getting shaken (= blurred) images increases. In addition, image noise level grows. The maximum exposure time in the night mode is ¼ seconds. Therefore, images need to be taken with extreme care and by supporting the phone when the amount of light reflected from the target is low. Because of the longer exposure time and larger gain value, noise level increases in low light conditions. Sometimes blurring may even occur in daytime, if the image is taken very carelessly. See the figure below for an example. This is normal; do not change the camera module.

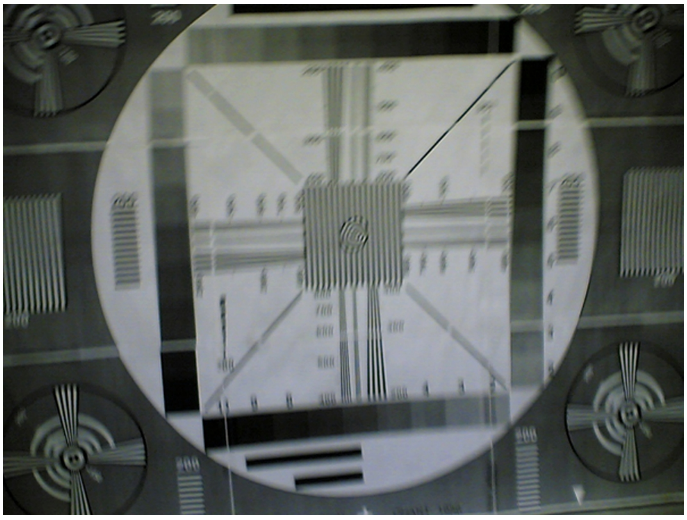


Figure 18 Blurring caused by shaking hands

Movement in bright light

If an image is taken of moving objects or if the device is used in a moving vehicle, object 'skewing' or 'tilting' may occur. This phenomenon is fundamental to most CMOS camera types, and may happen when using the electronic shutter. The movement of camera or object sometimes cause blurring indoors or in dim lighting conditions because of long exposure time. This is normal; do not change the camera module.

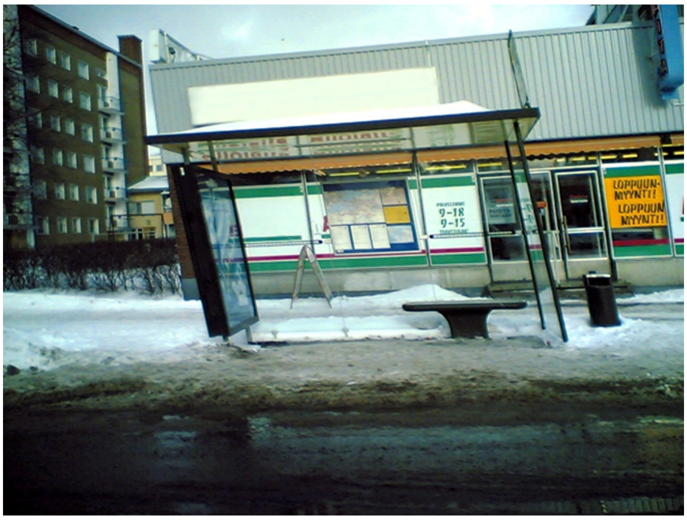


Figure 19 Near objects get skewed when taking images from a moving vehicle

Temperature

High temperatures inside the mobile phone cause more noise to appear in images. For example, in +70 degrees (Celsius), the noise level may be very high, and it further grows if the conditions are dim. If the phone processor has been heavily loaded for a long time before taking an image, the phone might have considerably higher temperature inside than in the surrounding environment. This is also normal to camera operation; do not change the camera module.

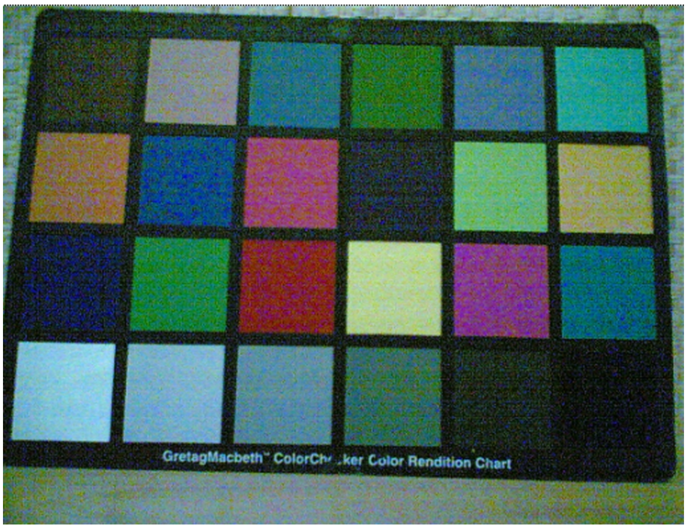


Figure 20 Noisy image taken in +70 degrees Celsius

Phone display

If the display contrast is set too dark, the image quality degrades: the images may be very dark depending on the setting. If the display contrast is set too bright, image contrast appears bad and "faint". This problem is solved by setting the display contrast correctly. This is normal behaviour; do not change the camera module.

Basic rules of photography (especially shooting against light)

Because of dynamic range limitations, taking images against bright light might cause either saturated image or the actual target appear too dark. In practice, this means that when taking an image indoors and having, for example, a window behind the object, the result is usually poor. This is normal behaviour; do not change the camera module.

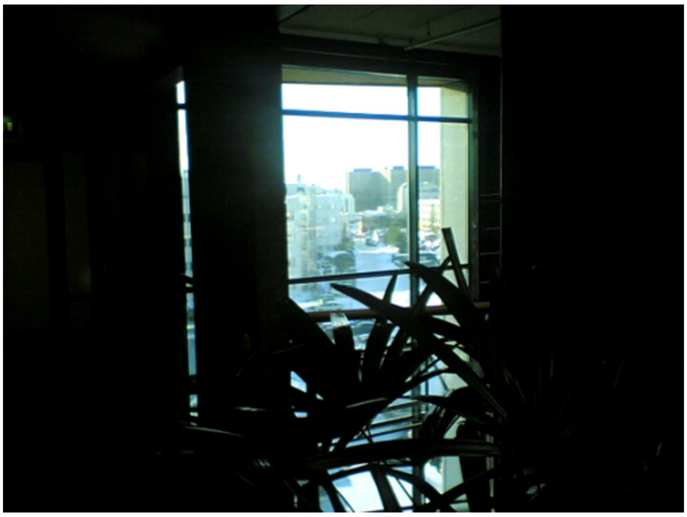


Figure 21 Image taken against light

Flicker

In some occasions a bright fluorescent light may cause flicker in the viewfinder and captured image. This phenomenon may also be a result, if images are taken indoors under the mismatch of 50/60 Hz electricity network frequency. The electricity frequency used is automatically detected by the camera module. In some very few countries, both 50 and 60 Hz networks are present and thus probability for the phenomenon increases. Flickering occurs also under high artificial illumination level. Flickering only occurs when the rolling shutter is used. This is normal behaviour; do not change the camera module.

Figure 22 Flicker in an image; object illuminated by strong fluorescent light

Bright light outside of image view

Especially the sun can cause clearly visible lens glare phenomenon and poor contrast in images. This happens because of undesired reflections inside the camera optics. Generally this kind of reflections are common in all optical systems. This is normal behaviour; do not change the camera module.

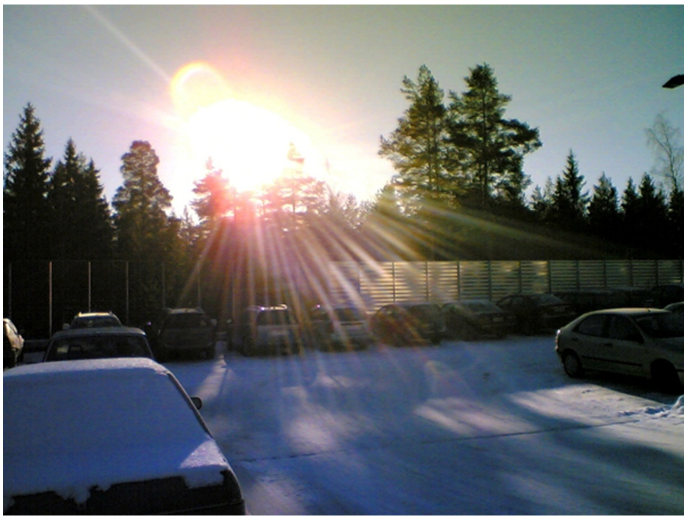


Figure 23 A lens reflection effect caused by sunshine

Examples of good quality images

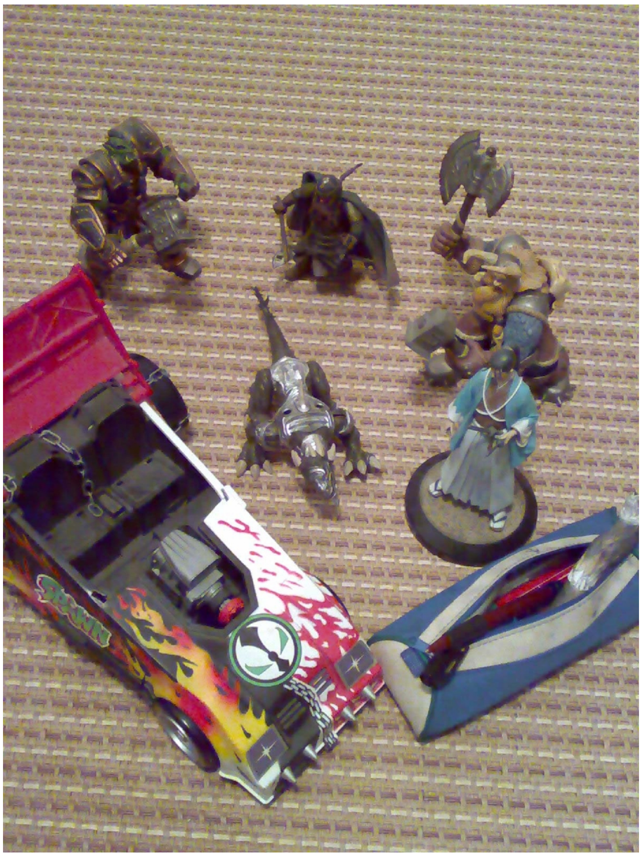


Figure 24 Good image taken indoors

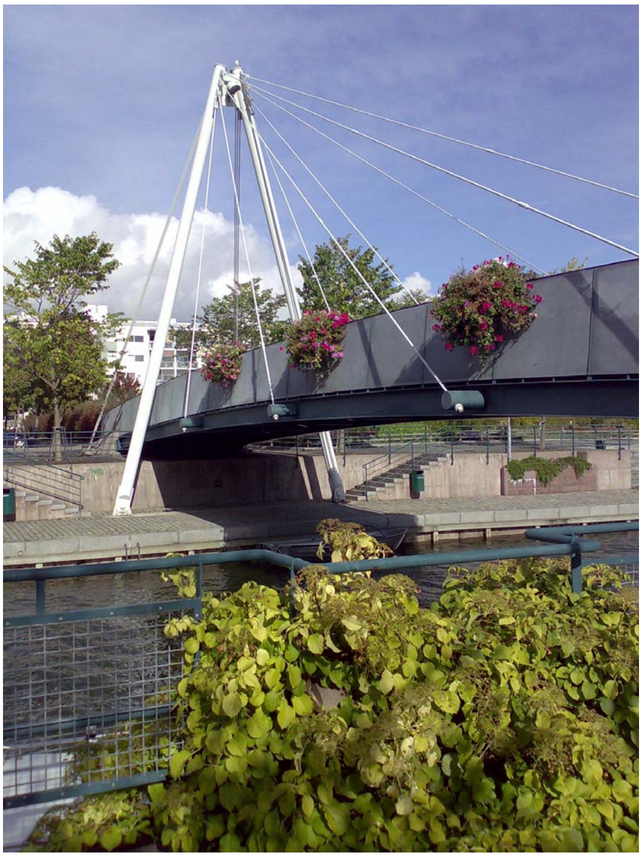


Figure 25 Good image taken outdoors

Image quality analysis

Possible faults in image quality

When checking for possible errors in camera functionality, knowing what error is suspected significantly helps the testing by narrowing down the amount of test cases. The following types of image quality problems may be expected to appear:

- Dust (black spots)
- Lack of sharpness
- Bit errors

In addition, there are many other kinds of possibilities for bad image quality, but those are ruled out from the scope of this document since the probability of their appearance is small.

Testing for dust in camera module

Symptoms and diagnosis

For detecting these kinds of problems, take an image of a uniform white surface and analyse it in full resolution. A good quality PC monitor is preferred for analysis. Search carefully, since finding these defects is not always easy. Figure "Effects of dust on optical path" is an example image containing easily detectable dust problems.

When taking a white image, use uniformly lightened white paper or white wall. One possibility is to use uniform light but in this case make sure that the camera image is not flickering when taking the test image. In case flickering happens, try to reduce illumination level. Use JPEG image format for analysing, and set the image quality parameter to ‘High Quality’.

Black spots in an image are caused by dirt particles trapped inside the optical system. Clearly visible and sharp edged black dots in an image are typically dust particles on the image sensor. These spots are searched for in the manufacturing phase, but it is possible that the camera body cavity contains a particle, which may move onto the image sensor active surface, for example, when the phone is dropped. Thus it is also possible that the problem will disappear before the phone is brought to service. The camera should be replaced if the problem is present when the service technician analyses the phone.

If a dust particle is lying on the infrared filter surface on either side, they are hard to locate because they are out of focus, and appear in the image as large, grayish and fading-edge 'blobs'. Sometimes they are invisible to the eye, and thus the user probably does not notice them at all. However, it is possible that a larger particle disturbs the user, causing need for service.

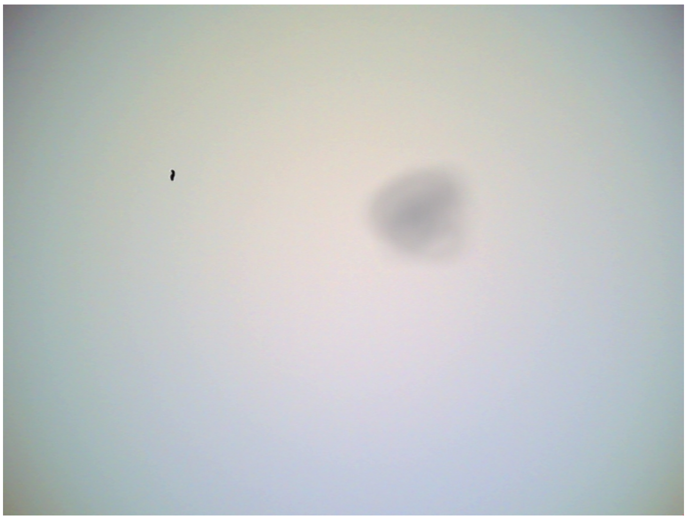


Figure 26 Effects of dust on optical path

If large dust particles get trapped on top of the lens surface in the cavity between camera window and lens, they will cause image blurring and poor contrast. The dust gasket between the window and lens should prevent any particles from getting into the cavity after the manufacturing phase.

If dust particles are found on the sensor, this is classified as a manufacturing error of the module and the camera should be replaced. Any particles inside the cavity between the protection window and lens have most probably been trapped there in the assembly phase at a Nokia factory. Unauthorized disassembling of the product can also be the root of the problem. However, in most cases it should be possible to remove the particle(s) by using clean compressed air. Never wipe the lens surface before trying compressed air; the possibility of damaging the lens is substantial. Always check the image sharpness after removing dust.

Testing camera image sharpness

Symptoms and diagnosis

If pictures taken with a device are claimed to be blurry, there are five possible sources for the problem:

1. The protection window is fingerprinted, soiled, dirty, visibly scratched or broken.
2. The camera module has failed to focus correctly, producing a blurred image.
3. User has tried to take pictures in too dark conditions and images are blurred due to handshake or movement. This is not a cause to replace camera module.
4. There is dirt between the protection window and the camera lens.
5. The protection window is defective. This can be either a manufacturing failure or caused by the user. The window should be changed.

A quantitative analysis of sharpness is very difficult to conduct in any other environment than optics laboratory. Therefore, subjective analysis should be used.

If no visible defects (items 1-4) are found, a couple of test images should be taken. Generally, a well-illuminated typical indoor scene, such as the one in Figure "Good image taken indoors", can be used as a target. The main considerations are:

- The camera module has to be given time to focus correctly. Correct focusing is normally indicated with a flashing icon or green bracket in the viewfinder. During focusing, the image in the viewfinder moves slightly back and fourth, this is normal and shows that the lens unit is moving. During the movement a faint sound can be heard from the camera head.
- The protection window has to be clean.
- The amount of light (300 – 600 lux (bright office lighting)) is sufficient.
- The scene should contain, for example, small objects for checking sharpness. Their distance should be 1 – 2 meters.
- If possible, compare the image to another image of the same scene, taken with a different device. Note that the reference device has to be a similar Nokia phone.

There are several conditions in which AF operation is challenging for the camera module, i.e. failing from time to time. These include:

- Low light scenes and night mode
- Scenes with low contrast
- Fast-moving objects

AF operation is disabled on purpose in “night”, “landscape”, “sports”, and “video” modes. When using these modes the lens is set to a predetermined focal position and isn’t moved during use.

Under low light and night mode the AF function is slower than under good light, it may even fail to find correct focus position. Low contrast scenes or fast moving objects may also slow down or cause AF to fail. This is normal operation, and is not a cause to replace camera.

The operation of AF can be tested by taking images of objects at different distances. Good distances are 20 cm, 60 cm and infinity (>3 m). Any LED or xenon flashes should not be used while taking the images.

The taken images should be analysed on PC screen at 100% scaling simultaneously with a reference image. Pay attention to the computer display settings; at least 65000 colors (16 bit) have to be used. 256 (8-bit) color setting is not sufficient; true color (24 bit, 16 million colors) or 32 bit (full color) setting is recommended.

If the differences are noticeable at a glance and also if the one under investigation is significantly inferior, the module might have a faulty lens. In this case, the module should be changed. Always recheck the resolution after changing the camera module. If a different module produces a clearly noticeable quality gap, the fault is probably in the camera window. Check the window by looking carefully through it when replacing the module. As references Figure "Good image taken indoors" and Figure "Good image taken outdoors" can be used. Another possibility is to use a service point comparison phone, if available.

Effects of dirty or defective camera lens protection window

The following series of images demonstrates the effects of fingerprints on the camera protection window.

> **Note:** The effects of any dirt in images can vary very much; it may be difficult to judge if the window has been dirty when some image has been taken or if something else has been wrong. That is why the cleanness of the protection window should always be checked and the window should be wiped clean with a suitable cloth.

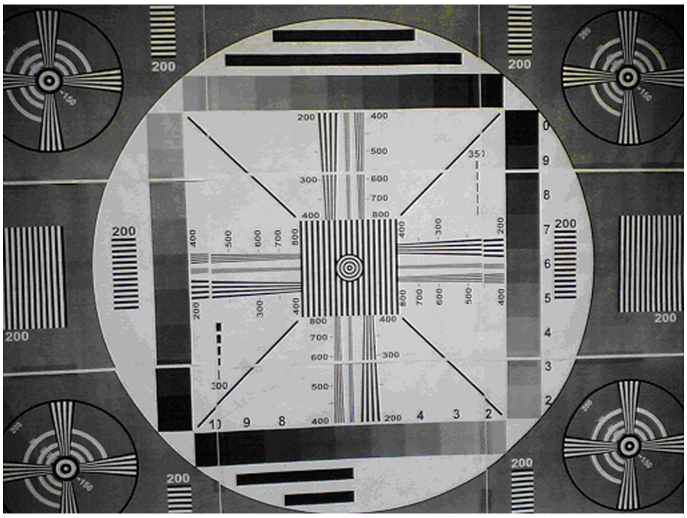


Figure 27 Image taken with clear protection window

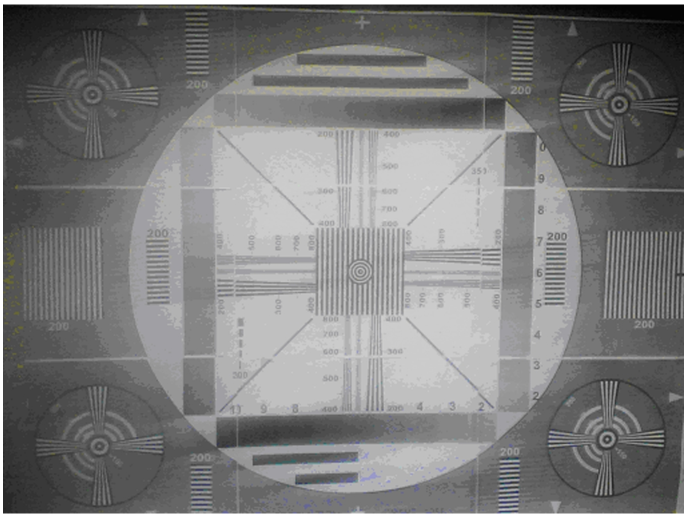


Figure 28 Image taken with greasy protection window

Bright point light sources might cause images that have flares around the light source if the protection window is dirty. A smeared fingerprint may be hard to see on the protective window but if will affect the image quality. These flares can be avoided by cleaning the window with a suitable cloth.

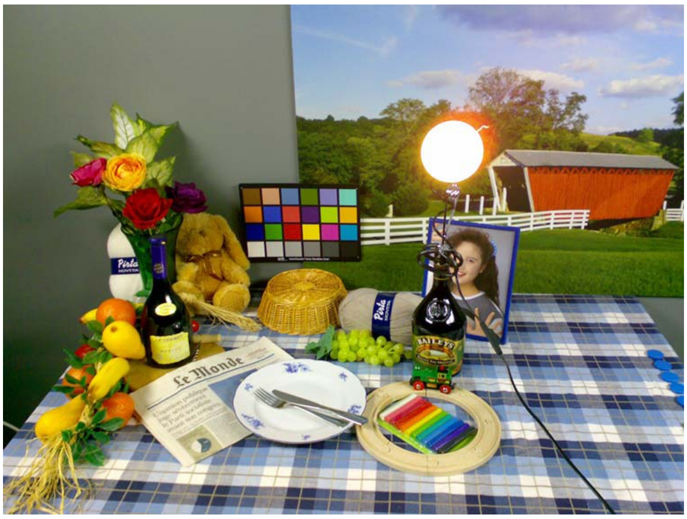


Figure 29 Image of point light sources taken with a clean protective window

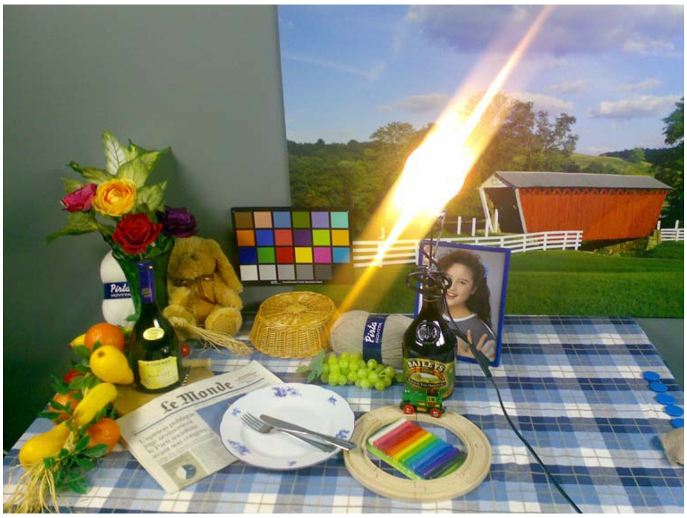


Figure 30 Image of point light sources taken with a dirty (finger print) protective window

Faulty pixels in images

Faulty pixels are pixels that do not respond to light in the same way as the pixels around them. There are three main types of faulty pixels, dead, stuck and hot pixels.

Dead pixels are always black or significantly darker than their surrounding. Dead pixels appear as black spots in all lightning conditions. Camera modules producing images with dead pixels that are clearly noticeable should be replaced.

If the pixel remains always saturated to its maximum value it is stuck. Stuck pixels may appear as red, green, blue or white spots in all lightning conditions. Camera modules producing images with one or more stuck pixels should be replaced.

Hot pixels are pixels that easily saturate in dim light conditions. It is normal to get a lot of noise and hot pixels in night conditions or otherwise dark conditions. The hot pixels should disappear when the ambient light is increased, but may still appear in darker areas of an otherwise well illuminated scene.

When examining an image for defect pixels, test images should be viewed as 100% enlargements on a PC monitor.

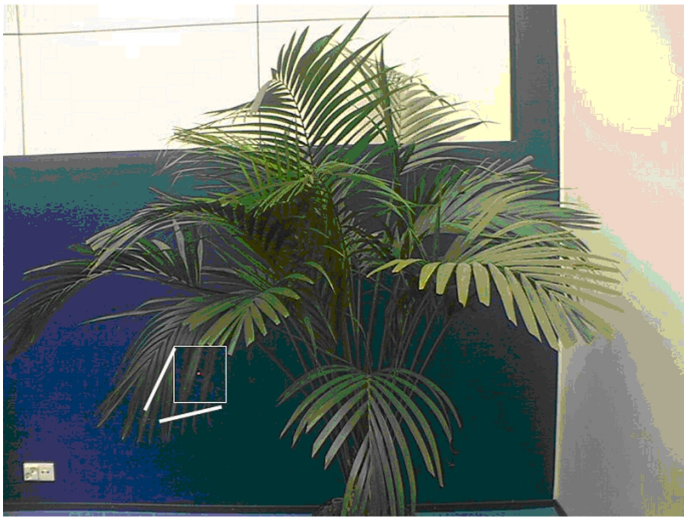


Figure 31 Enlargement of a hot pixel

Flash photography problems

Use of flash device may affect the image in many ways.

- White balance errors. The image may get a wrong tone due to mixing of flash colour temperature and ambient lightning. This is unwanted but normal feature.
- Dust reflections. Dust or water drops in front of the flash unit may reflect strongly to the camera sensor. See the following figure.

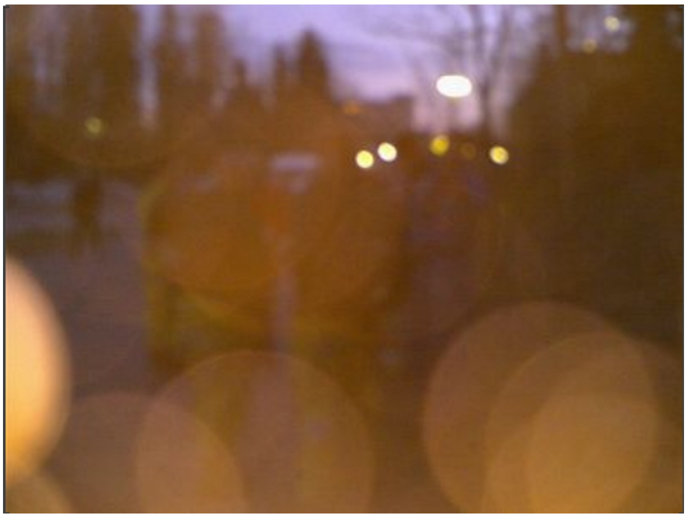


Figure 32 Light from the flash has reflected on particles in front of the camera

Camera construction

This section describes the mechanical construction of the camera module for getting a better understanding of the actual mechanical structure of the module.

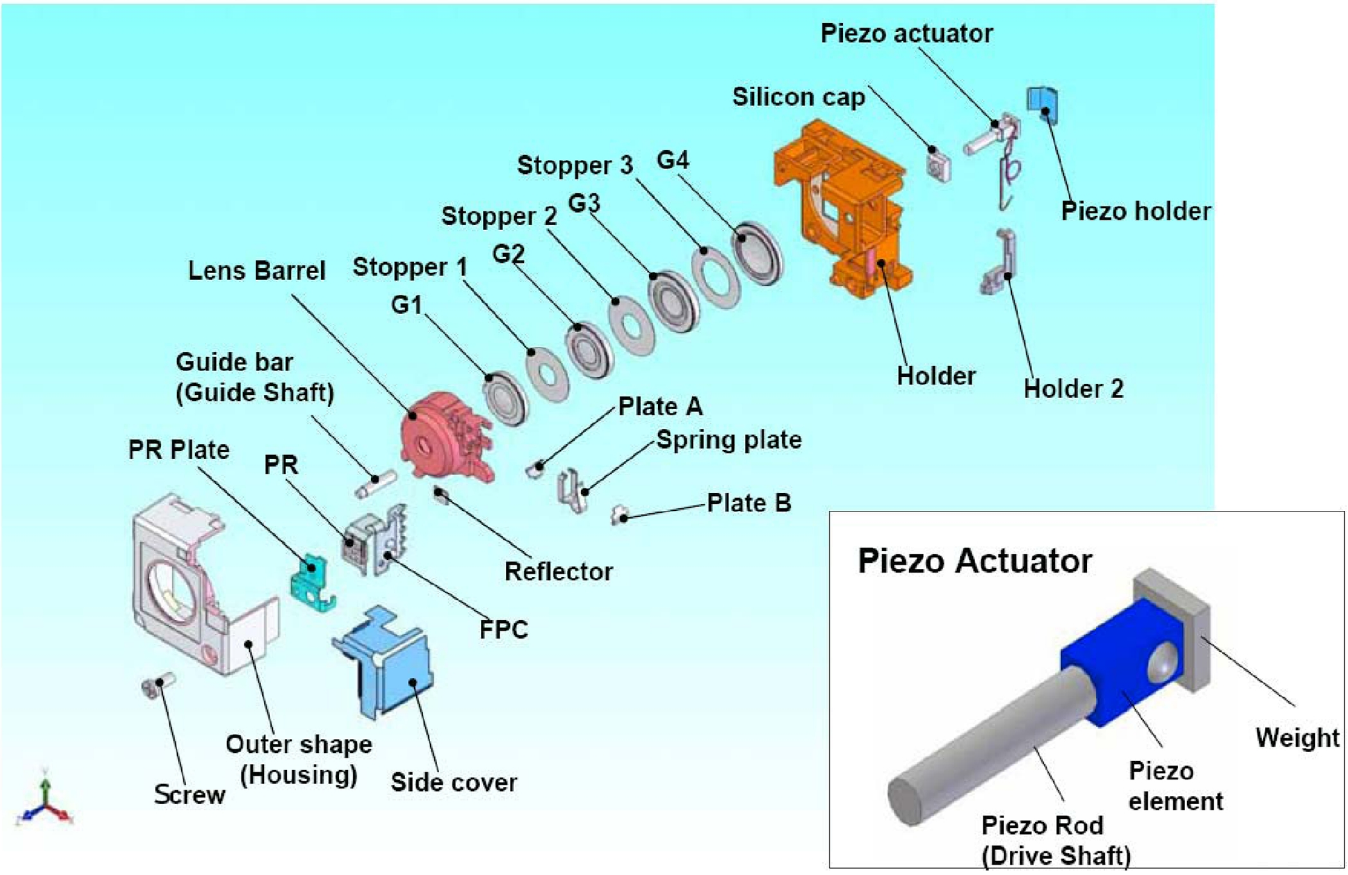

Piezo actuator
Silicon cap
Piezo holder
Stopper 3
G4
G3
Stopper 2
G2
Lens Barrel
Stopper 1
G1
Holder
Holder 2
Guide bar
(Guide Shaft)
Plate A
Spring plate
PR Plate
PR
Plate B
Reflector
FPC
Outer shape
(Housing)
Screw
Side cover
Piezo Actuator
Weight
Piezo element
Piezo Rod
(Drive Shaft)

Figure 33 Exploded view of the camera module (without sensor array and PWB shown)

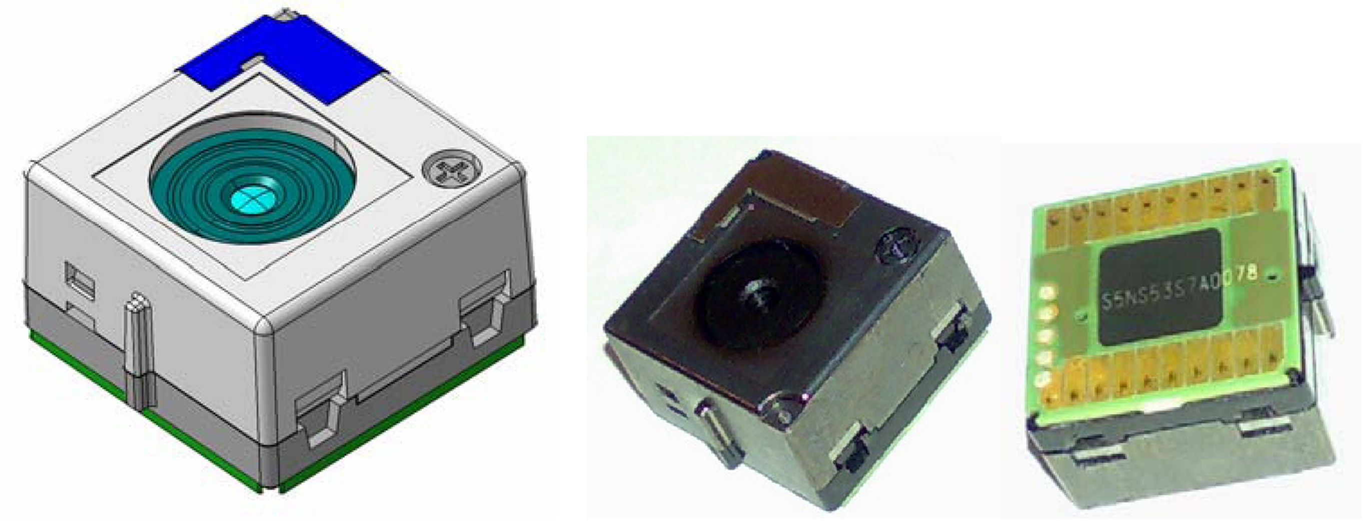

S5NS5357A0078

Figure 34 Camera module top and bottom views including imaginary view cone

The camera module as a component is not a repairable part, meaning that the components inside the module may not be changed. Cleaning dust from the front face is allowed only. Use clean compressed air.

The main parts of the module are:

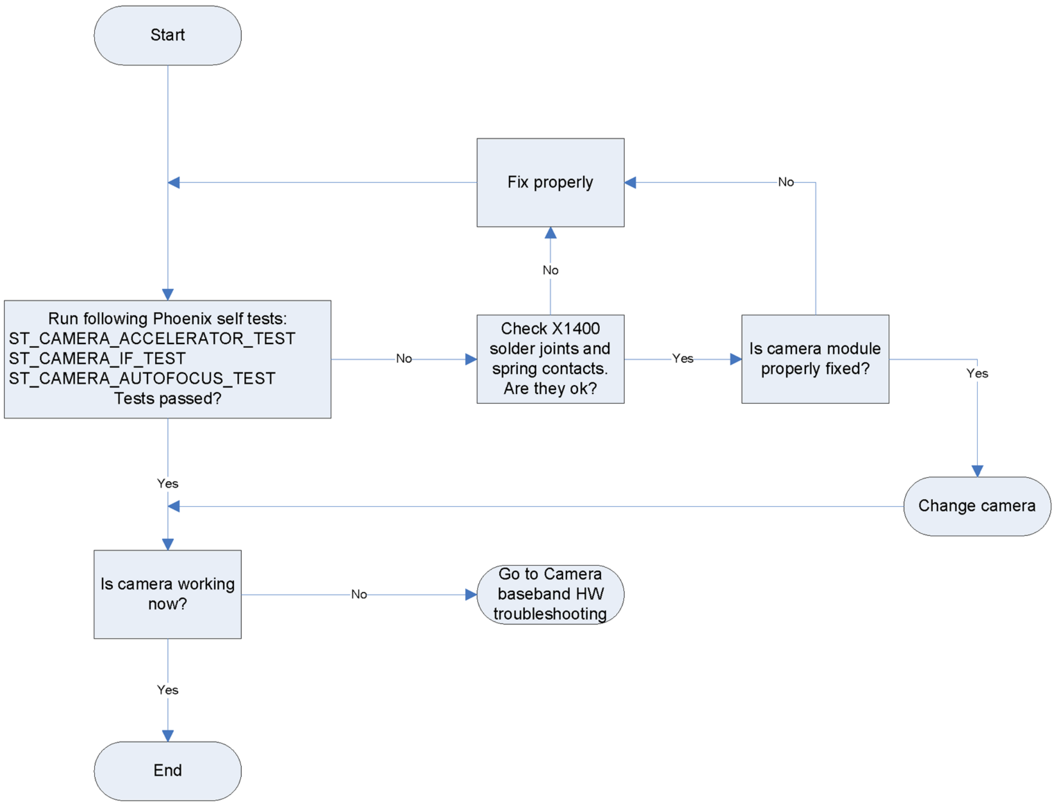
- Lens unit including lens aperture.
- Actuator for lens movement
- Infrared filter; used to prevent infrared light from contaminating the image colors.
- Sensor array is glued and wire bonded to PWB. External DSP is mounted in the handset.

- PWB, FR-4 type
- Laser-marked serial numbering on PWB (for versioning)
- Passive components
- Camera protection window; part of the phone cover mechanics
- Outer casing

Main (back) camera troubleshooting flowcharts

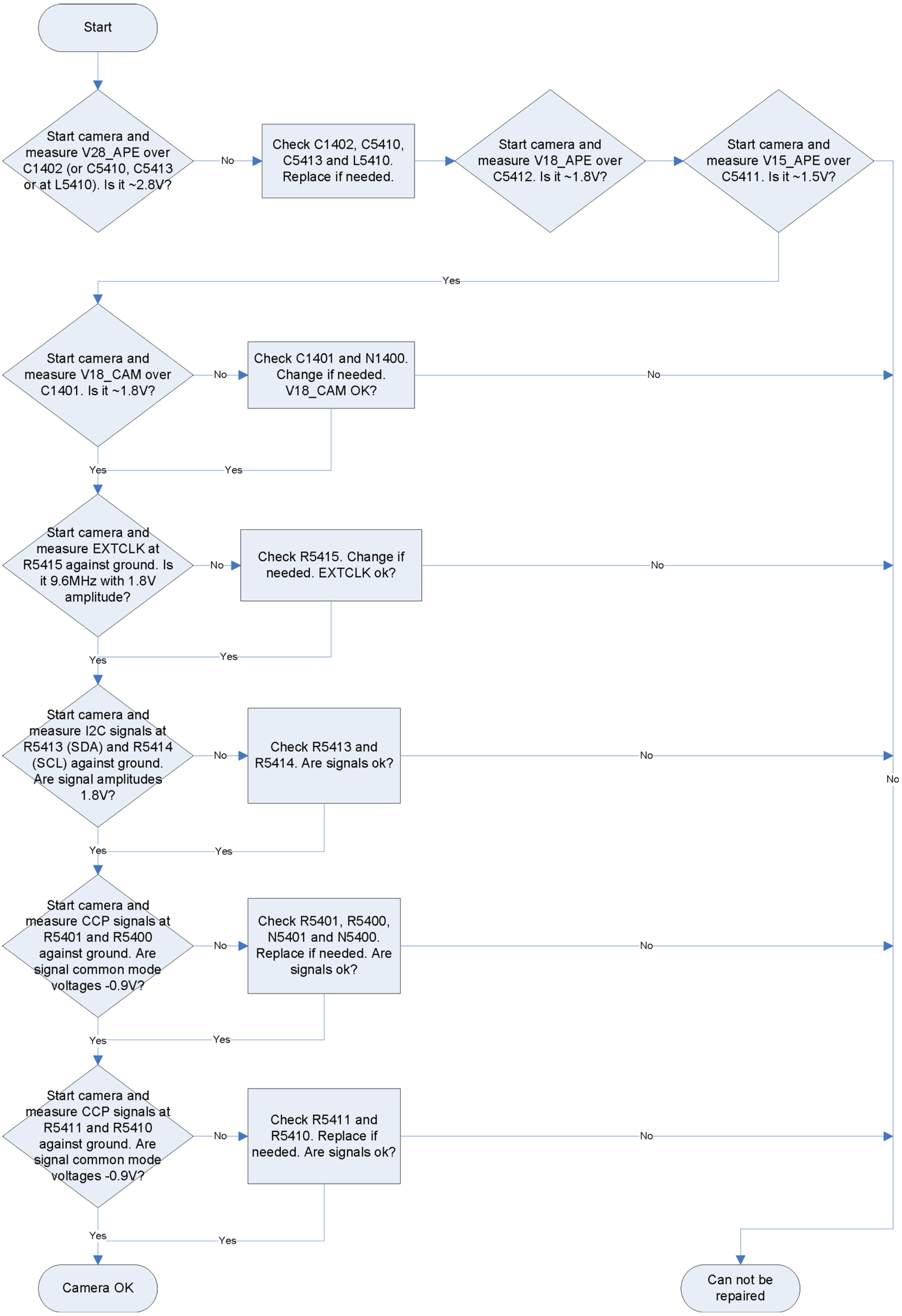
Main camera troubleshooting

Troubleshooting flow


Start
Fix properly
No
No
Run following Phoenix self tests:
ST_CAMERA_ACCELERATOR_TEST
ST_CAMERA_IF_TEST
ST_CAMERA_AUTOFOCUS_TEST
Tests passed?
No
Check X1400 solder joints and spring contacts. Are they ok?
Yes
Is camera module properly fixed?
Yes
Yes
Change camera
Is camera working now?
No
Go to Camera baseband HW troubleshooting
Yes
End

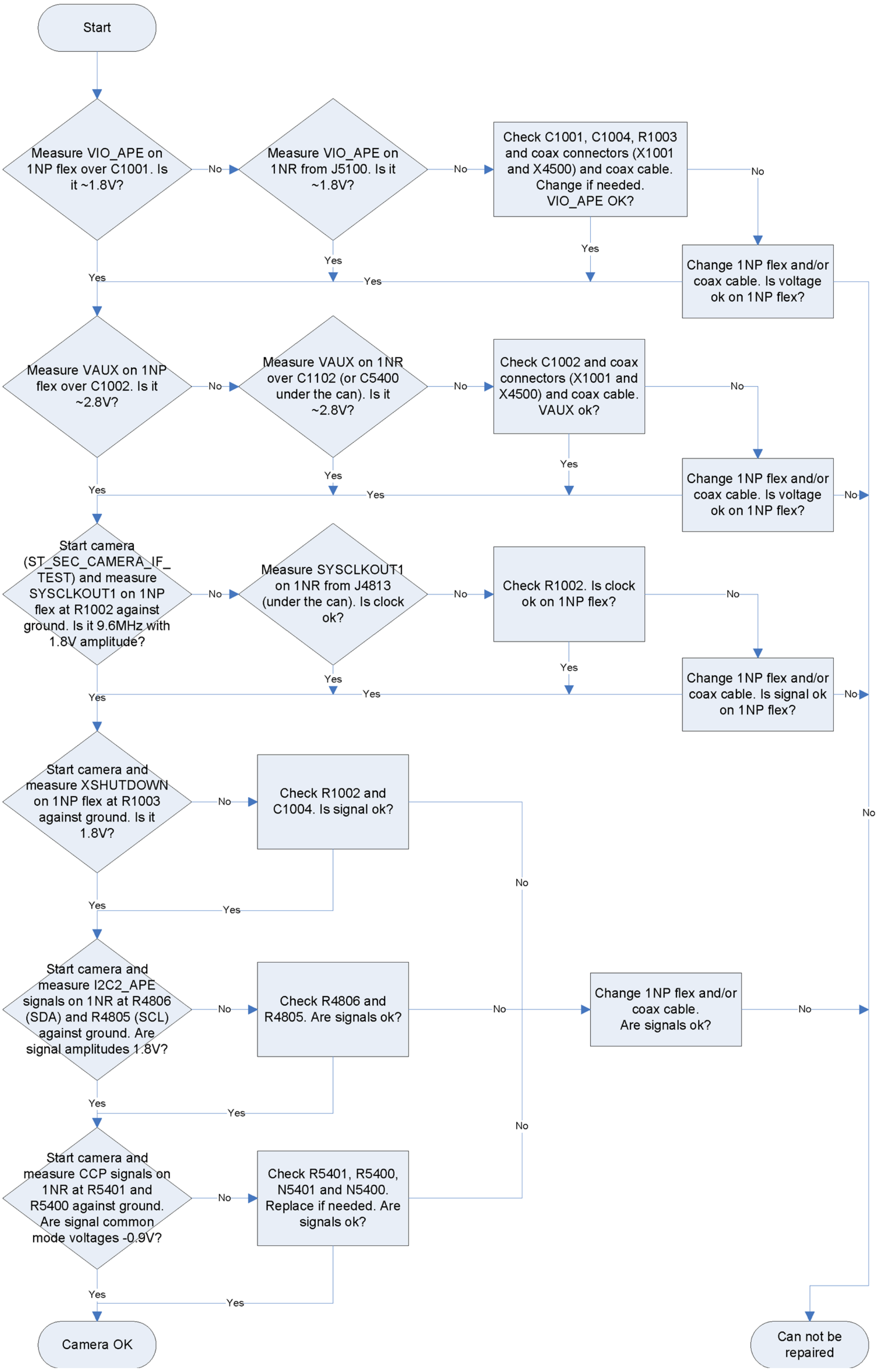
Main camera HW failure troubleshooting

Troubleshooting flow


Start
Start camera and measure V28_APE over C1402 (or C5410, C5413 or at L5410). Is it ~2.8V?
No
Check C1402, C5410, C5413 and L5410. Replace if needed.
Start camera and measure V18_APE over C5412. Is it ~1.8V?
Start camera and measure V15_APE over C5411. Is it ~1.5V?
Yes
Start camera and measure V18_CAM over C1401. Is it ~1.8V?
No
Check C1401 and N1400. Change if needed. V18_CAM OK?
No
Yes
Yes
Start camera and measure EXTCLK at R5415 against ground. Is it 9.6MHz with 1.8V amplitude?
No
Check R5415. Change if needed. EXTCLK ok?
No
Yes
Yes
Start camera and measure I2C signals at R5413 (SDA) and R5414 (SCL) against ground. Are signal amplitudes 1.8V?
No
Check R5413 and R5414. Are signals ok?
No
No
Yes
Yes
Start camera and measure CCP signals at R5401 and R5400 against ground. Are signal common mode voltages -0.9V?
No
Check R5401, R5400, N5401 and N5400. Replace if needed. Are signals ok?
No
Yes
Yes
Start camera and measure CCP signals at R5411 and R5410 against ground. Are signal common mode voltages -0.9V?
No
Check R5411 and R5410. Replace if needed. Are signals ok?
No
Yes
Yes
Camera OK
Can not be repaired

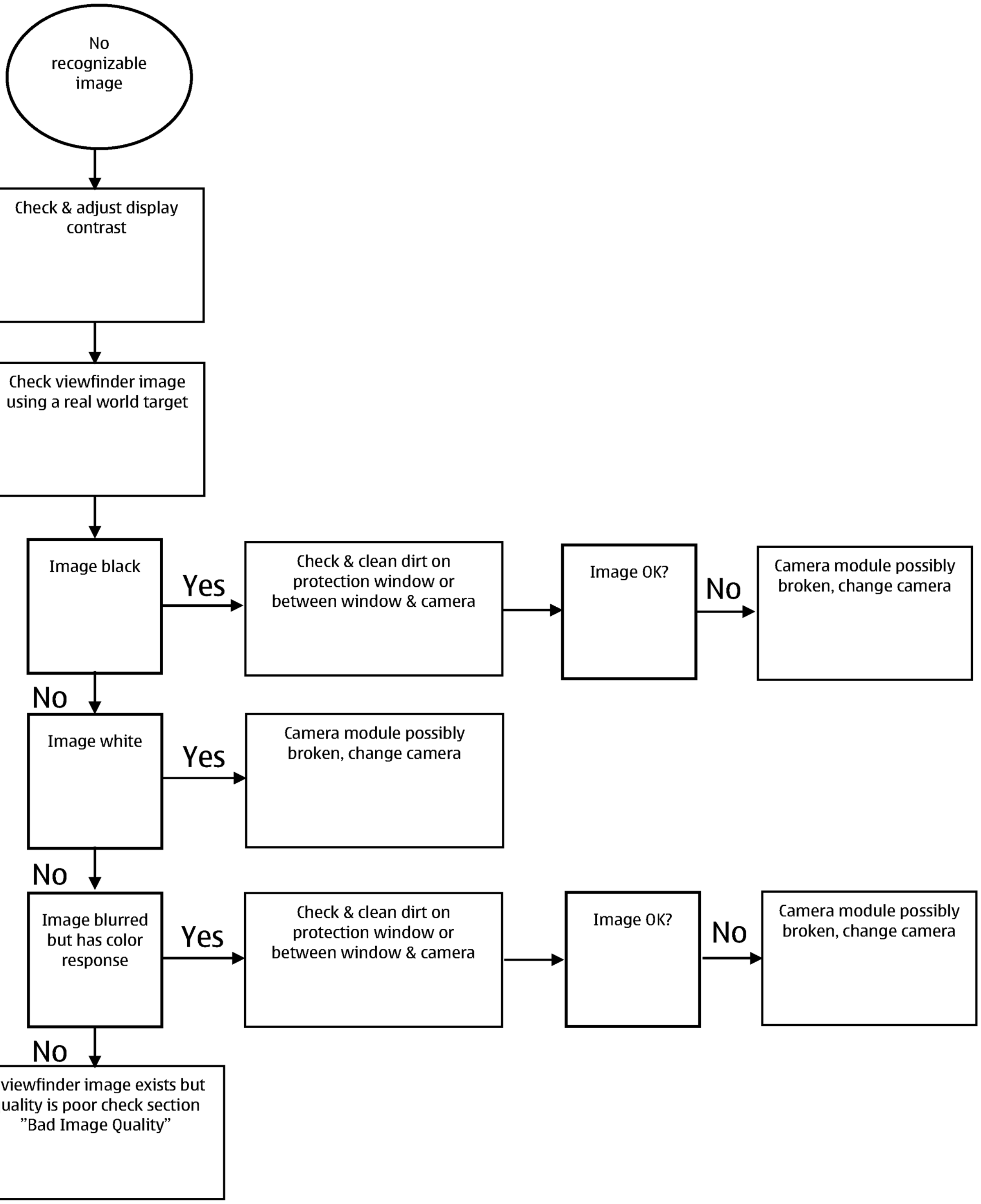
Secondary camera HW BB troubleshooting

Troubleshooting flow


Start
Measure VIO_APE on 1NP flex over C1001. Is it ~1.8V?
No
Measure VIO_APE on 1NR from J5100. Is it ~1.8V?
No
Check C1001, C1004, R1003 and coax connectors (X1001 and X4500) and coax cable. Change if needed. VIO_APE OK?
No
Yes
Yes
Yes
Yes
Change 1NP flex and/or coax cable. Is voltage ok on 1NP flex?
Measure VAUX on 1NP flex over C1002. Is it ~2.8V?
No
Measure VAUX on 1NR over C1102 (or C5400 under the can). Is it ~2.8V?
No
Check C1002 and coax connectors (X1001 and X4500) and coax cable. VAUX ok?
No
Yes
Yes
Yes
Yes
Change 1NP flex and/or coax cable. Is voltage ok on 1NP flex?
No
Start camera (ST_SEC_CAMERA_IF_TEST) and measure SYSCLKOUT1 on 1NP flex at R1002 against ground. Is it 9.6MHz with 1.8V amplitude?
No
Measure SYSCLKOUT1 on 1NR from J4813 (under the can). Is clock ok?
No
Check R1002. Is clock ok on 1NP flex?
No
Yes
Yes
Yes
Yes
Change 1NP flex and/or coax cable. Is signal ok on 1NP flex?
No
No
Start camera and measure XSHUTDOWN on 1NP flex at R1003 against ground. Is it 1.8V?
No
Check R1002 and C1004. Is signal ok?
No
Yes
Yes
Start camera and measure I2C2_APE signals on 1NR at R4806 (SDA) and R4805 (SCL) against ground. Are signal amplitudes 1.8V?
No
Check R4806 and R4805. Are signals ok?
No
Change 1NP flex and/or coax cable. Are signals ok?
No
Yes
Yes
No
Start camera and measure CCP signals on 1NR at R5401 and R5400 against ground. Are signal common mode voltages -0.9V?
No
Check R5401, R5400, N5401 and N5400. Replace if needed. Are signals ok?
Yes
Yes
Camera OK
Can not be repaired

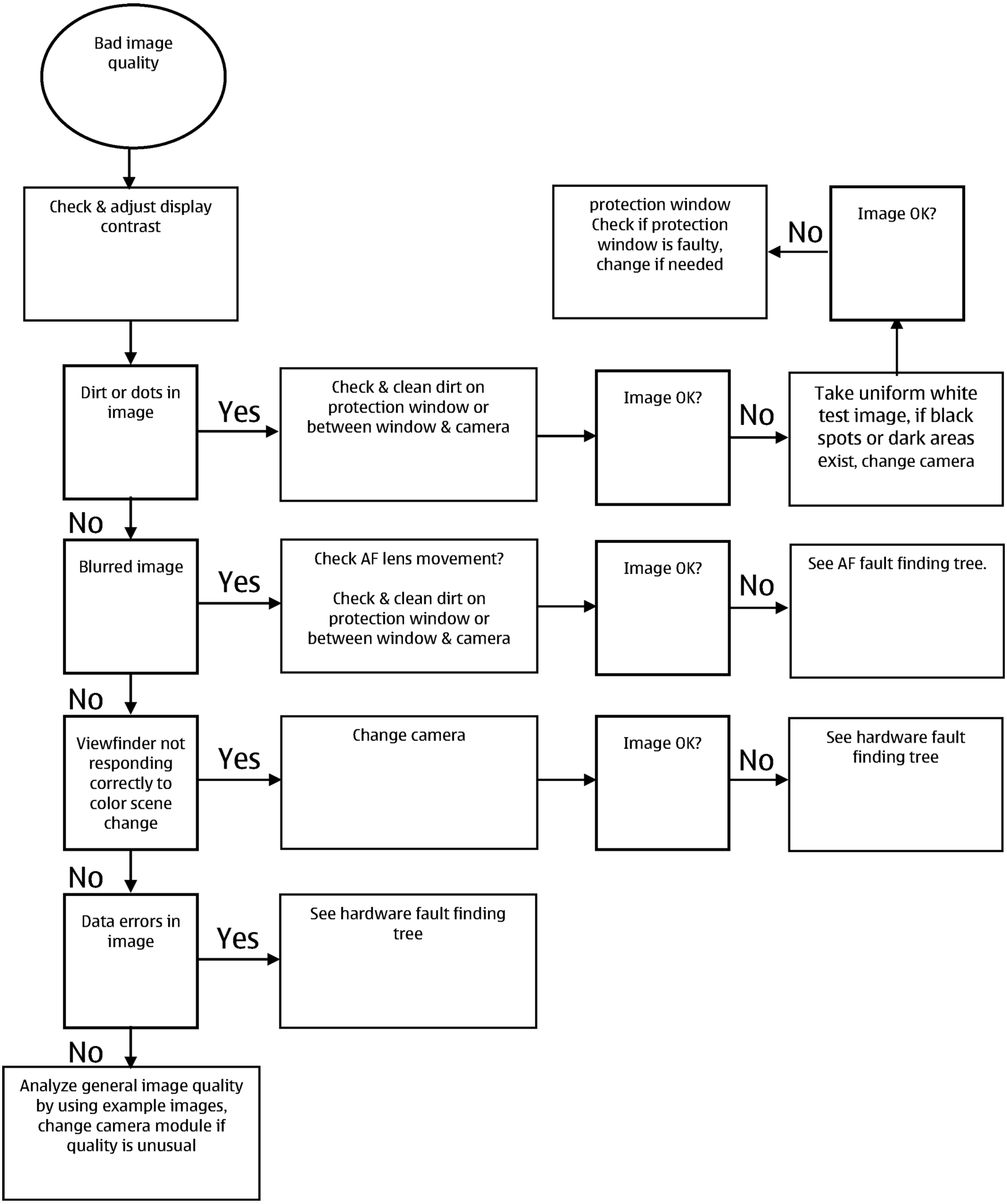
No recognizable viewfinder image

Troubleshooting flow


No recognizable image
Check & adjust display contrast
Check viewfinder image using a real world target
Image black
Yes
Check & clean dirt on protection window or between window & camera
Image OK?
No
Camera module possibly broken, change camera
No
Image white
Yes
Camera module possibly broken, change camera
No
Image blurred but has color response
Yes
Check & clean dirt on protection window or between window & camera
Image OK?
No
Camera module possibly broken, change camera
No
If viewfinder image exists but quality is poor check section ”Bad Image Quality”

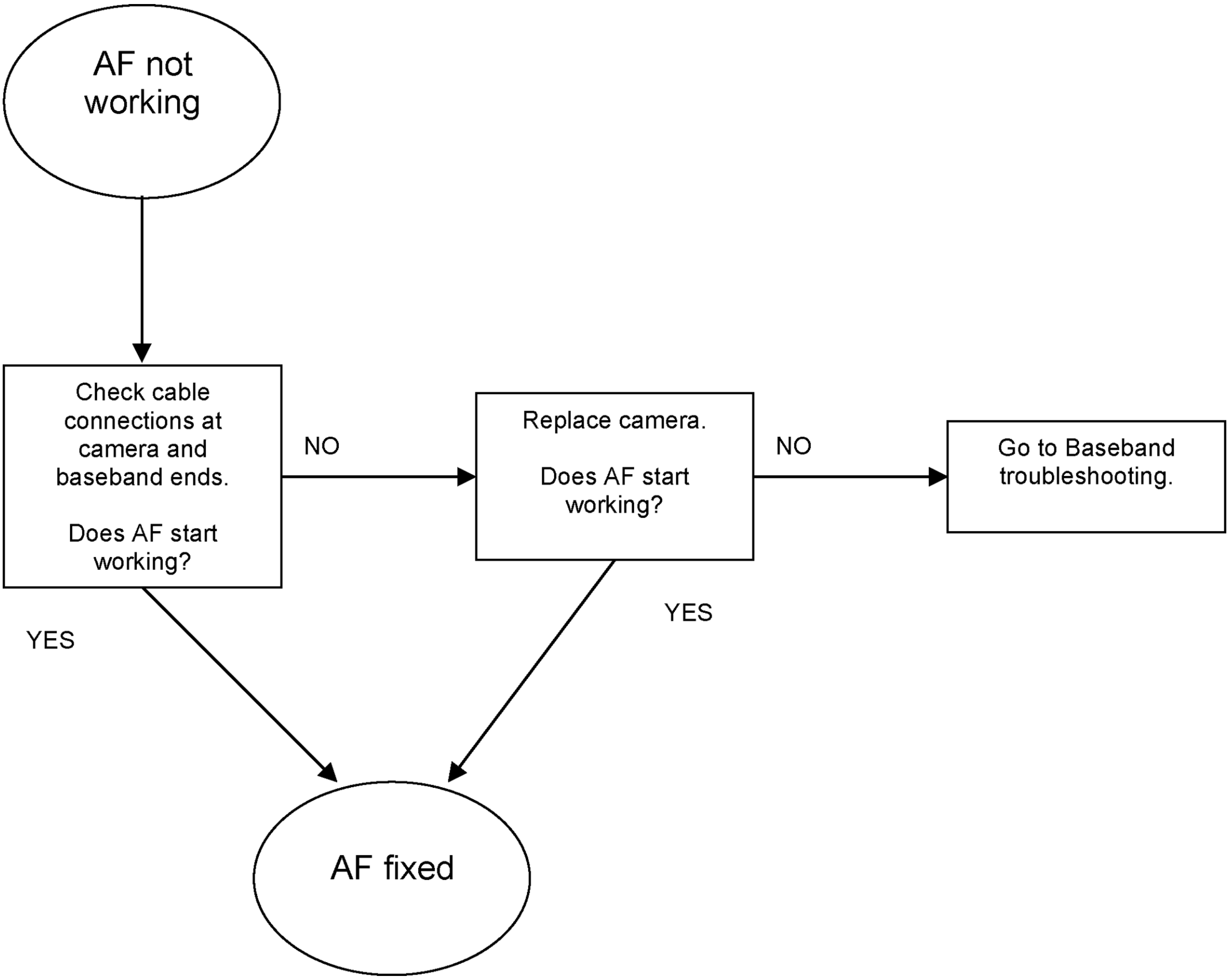
Bad camera image quality troubleshooting

Troubleshooting flow


Bad image quality
Check & adjust display contrast
Dirt or dots in image
Yes
Check & clean dirt on protection window or between window & camera
Image OK?
No
Take uniform white test image, if black spots or dark areas exist, change camera
Image OK?
No
protection window Check if protection window is faulty, change if needed
No
Blurred image
Yes
Check AF lens movement?
Check & clean dirt on protection window or between window & camera
Image OK?
No
See AF fault finding tree.
No
Viewfinder not responding correctly to color scene change
Yes
Change camera
Image OK?
No
See hardware fault finding tree
No
Data errors in image
Yes
See hardware fault finding tree
No
Analyze general image quality by using example images, change camera module if quality is unusual

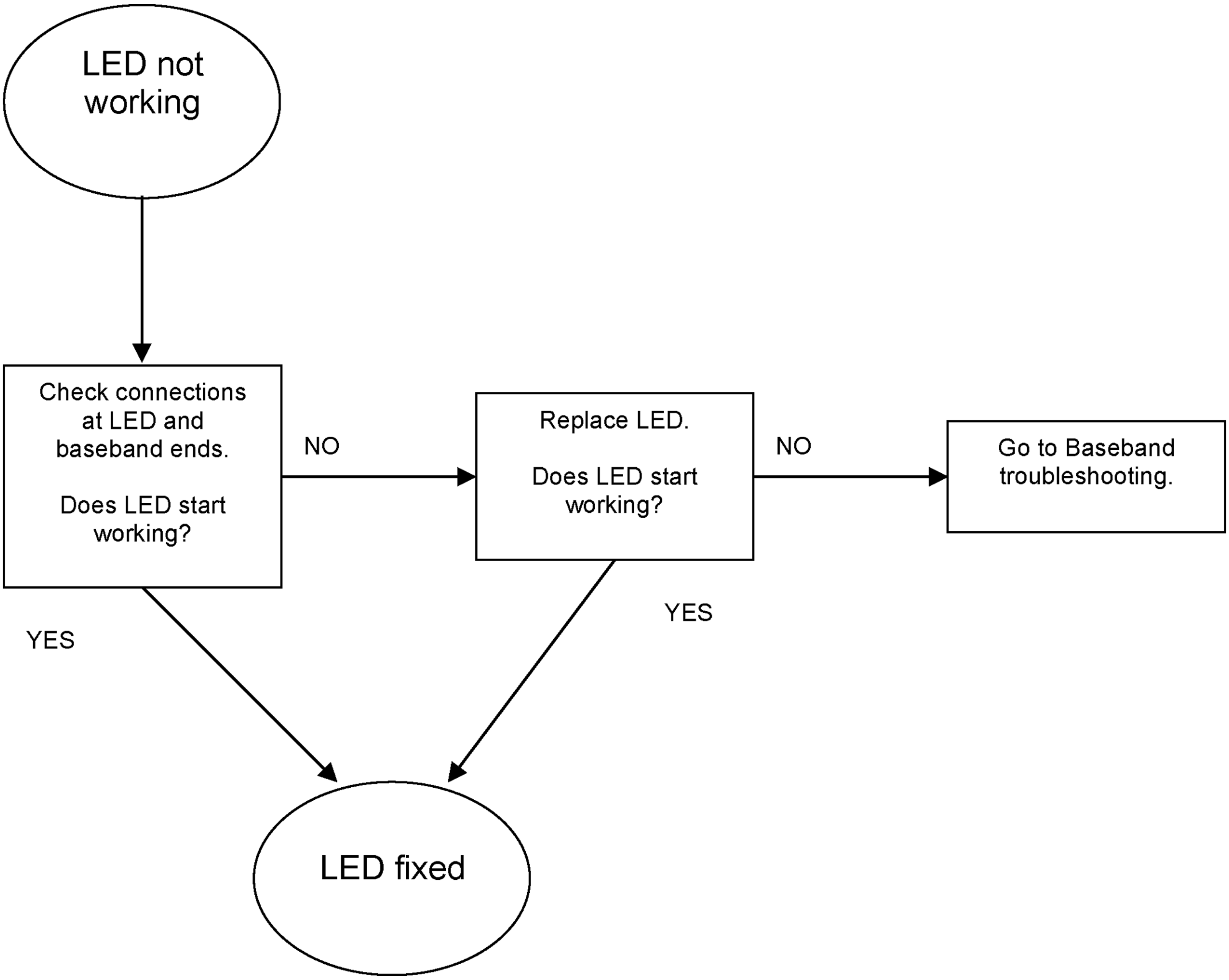
Camera autofocus troubleshooting

Troubleshooting flow


AF not working
Check cable connections at camera and baseband ends.
Does AF start working?
NO
Replace camera.
Does AF start working?
NO
Go to Baseband troubleshooting.
YES
YES
AF fixed

LED flash troubleshooting

Troubleshooting flow


LED not working
Check connections at LED and baseband ends.
Does LED start working?
NO
Replace LED.
Does LED start working?
NO
Go to Baseband troubleshooting.
YES
YES
LED fixed

6 — System Module

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Baseband description

System module block diagram

The device consists of two different main modules: transceiver and UI. The transceiver board consists of baseband and RF components. The UI board consists of key domes and keypad backlights. Connection between the UI and the transceiver board is established via a board-to-board spring connector.

> **Note:** In this description, the user interface HW covers display, camera, keyboard, keyboard backlight and ALS.

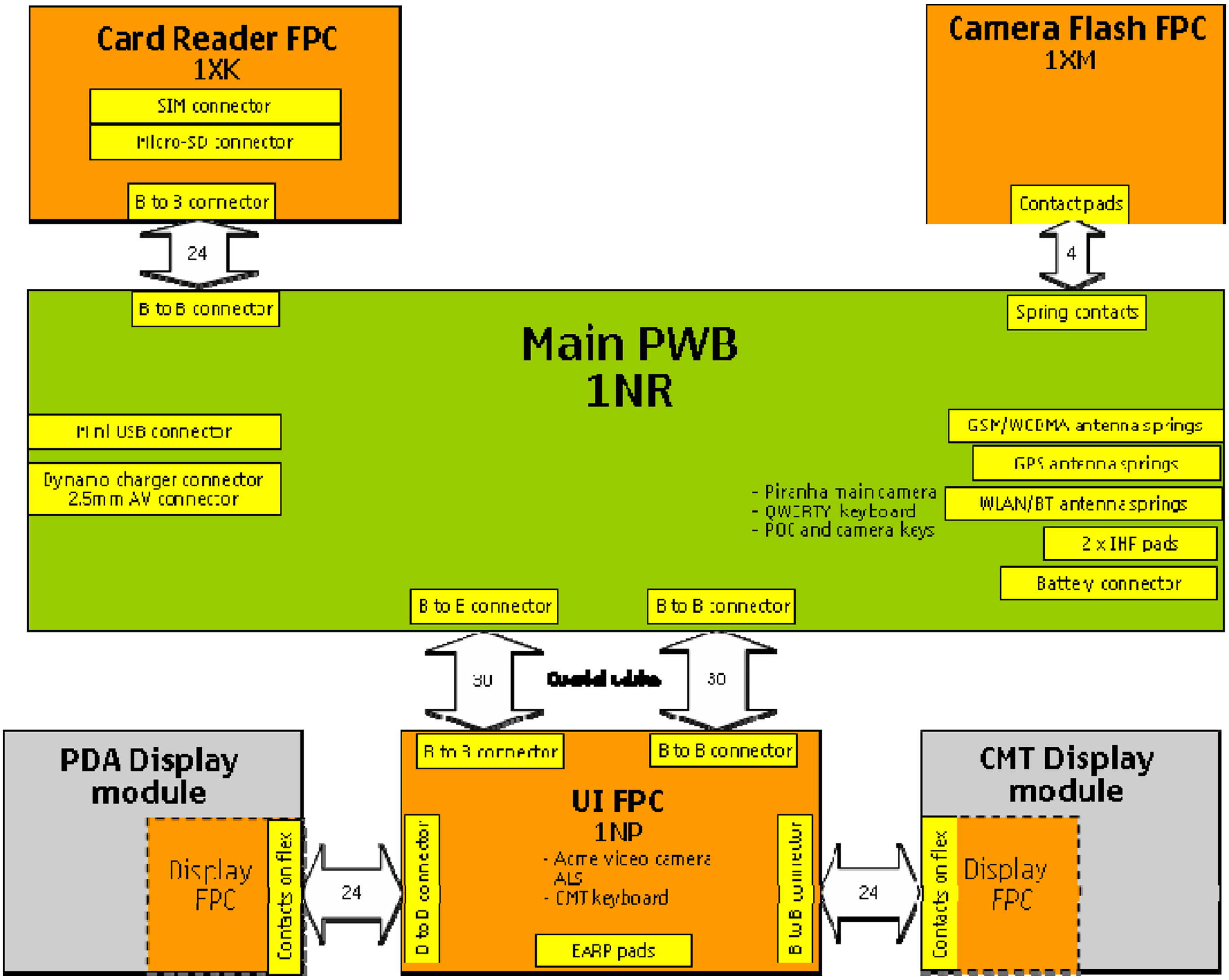

Card Reader FPC
1XK
SIM connector
Micro-SD connector
B to B connector
24
Camera Flash FPC
1XM
Contact pads
4
B to B connector
Spring contacts
Main PWB
1NR
Mini USB connector
Dynamo charger connector
2.5mm AV connector
- Piranha main camera
- QWERTY keyboard
- POC and camera keys
GSM/WCDMA antenna springs
GPS antenna springs
WLAN/BT antenna springs
2 x IHF pads
Battery connector
B to E connector
B to B connector
30
30
B to B connector
B to B connector
PDA Display module
Display FPC
Contacts on flex
24
UI FPC
1NP
- Acme video camera
ALS
- CMT keyboard
D to D connector
B to B connector
EARP pads
24
CMT Display module
Contacts on flex
Display FPC

Figure 35 System level block diagram

Baseband functional description

Digital baseband consists of an ISA (Intelligent Software Architecture) based modem and Symbian based application sections. The modem functionality is in RAP, and the application processor acts as a platform for Symbian applications. The terms ISA and Symbian are used refer to the software environment of these devices.

The modem section consists of a RAP ASIC with NOR FLASH and SDRAM memory as the core. RAP supports WCDMA and GSM cellular protocols. The modem DDR SDRAM memory has 128 Mbits of memory and NOR flash has 128 Mbits of memory. RAP operates with the system clock of 38.4 MHz, which comes from the VCTCXO.

The application section includes an application processor ASIC with DDR/NAND combo memory as the core.

Application processor

The application processor is also called an application ASIC because it is processing application SW and handles the UI SW. It consists of the application processor and peripheral subsystems such as camera, display and keyboard driver blocks.

In addition to interfaces mentioned above, the peripherals block includes several different I/O interfaces, for example, for keyboard, modem chip, audio, Bluetooth and so on.

Absolute maximum ratings

Signal	Min	Nom	Max	Unit	Notes
Battery voltage (idle)	-0.3		+4.5	V	Battery voltage maximum value is specified during charging is active
Battery voltage (Call)	+3.2		+4.3	V	Battery voltage maximum value is specified during charging is active
Charger input voltage	-0.3		+20	V	
Back-Up supply voltage	0	2.5	2.6	V	Maximum capacity of the backup power supply assumed to be 10 µAh.

Phone modes of operation

Mode	Description
NO_SUPPLY	(dead) mode means that the main battery is not present or its voltage is too low (below EM ASIC N2200 master reset threshold) and that the back-up battery voltage is too low.
BACK_UP	The main battery is not present or its voltage is too low but back-up battery voltage is adequate and the 32kHz oscillator is running (RTC is on).
PWR_OFF	In this mode (warm), the main battery is present and its voltage is over EM ASIC N2200 master reset threshold. All regulators are disabled, PurX is on low state, the RTC is on and the oscillator is on. PWR_OFF (cold) mode is almost the same as PWR_OFF (warm), but the RTC and the oscillator are off.
RESET	RESET mode is a synonym for start-up sequence. In this mode certain regulators are enabled and after they and RFClk have stabilized, the system reset (PurX) is released and PWR_ON mode entered. RESET mode uses 32kHz clock to count the REST mode delay (typically 16ms).
SLEEP	SLEEP mode is entered only from PWR_ON mode with the aid of SW when the system's activity is low.
FLASHING	FLASHING mode is for SW downloading.

Voltage limits

Parameter	Description	Value
VMSTR	Master reset threshold (N2200)	2.2V (typ.)
VMSTR+	Threshold for charging, rising (N2300)	2.1V (typ.)

Parameter	Description	Value
VMSTR-	Threshold for charging, falling (N2300)	1.9V (typ.)
VCOFF+	Hardware cutoff (rising)	2.9V (typ.)
VCOFF-	Hardware cutoff (falling)	2.6V (typ.)
SWCOFF	SW cutoff limit	~3.2V

The master reset threshold controls the internal reset of EM ASICs. If battery voltage is above VMSTR, N2300 charging control logic is alive. Also, RTC is active and supplied from the main battery. Above VMSTR, N2300 allows the system to be powered on although this may not succeed due to voltage drops during start up. SW can also consider battery voltage too low for operation and power down the system.

Power key

The system boots up when power key is pressed (adequate battery voltage, VBAT, present).

Power down can be initiated by pressing the power key again (the system is powered down with the aid of SW). Power on key is connected to the EM ASIC N2200 via PWRONX signal.

Power distribution

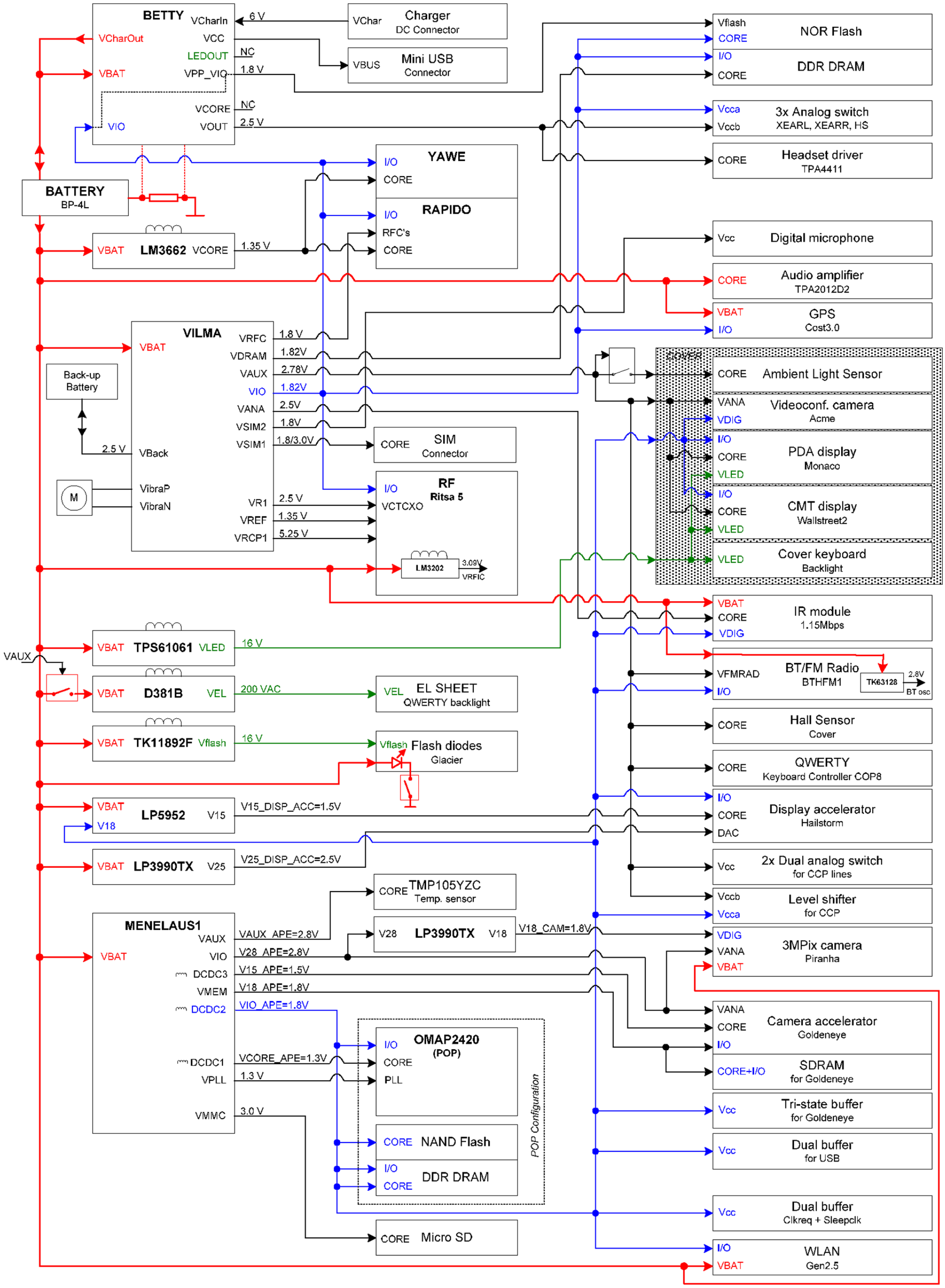

BETTY
VCharIn
VCharOut
VCC
LEDOUT
VBAT
VPP_VIO
VCORE
VIO
VOUT
6 V
NC
1.8 V
NC
2.5 V
VChar
Charger
DC Connector
VBUS
Mini USB
Connector
BATTERY
BP-4L
VBAT
LM3662
VCORE
1.35 V
I/O
YAWE
CORE
I/O
RAPIDO
RFC's
CORE
VILMA
VBAT
VRFC
VDRAM
VAUX
VIO
VANA
VSIM2
VSIM1
VBack
VibraP
VibraN
VR1
VREF
VRCP1
1.8 V
1.82V
2.78V
1.82V
2.5V
1.8V
1.8/3.0V
2.5 V
1.35 V
5.25 V
Back-up
Battery
2.5 V
M
CORE
SIM
Connector
I/O
RF
Ritsa 5
VCTCXO
LM3202
3.09V
VRFIC
VAUX
VBAT
TPS61061
VLED
16 V
VBAT
D381B
VEL
200 VAC
VEL
EL SHEET
QWERTY backlight
VBAT
TK11892F
Vflash
16 V
Vflash
Flash diodes
Glacier
VBAT
V18
LP5952
V15
V15_DISP_ACC=1.5V
VBAT
LP3990TX
V25
V25_DISP_ACC=2.5V
CORE
TMP105YZC
Temp. sensor
MENELAUS1
VBAT
VAUX
VIO
DCDC3
VMEM
DCDC2
DCDC1
VPLL
VMMC
VAUX_APE=2.8V
V28_APE=2.8V
V15_APE=1.5V
V18_APE=1.8V
VIO_APE=1.8V
VCORE_APE=1.3V
1.3 V
3.0 V
V28
LP3990TX
V18
V18_CAM=1.8V
I/O
OMAP2420
(POP)
CORE
PLL
CORE
NAND Flash
I/O
CORE
DDR DRAM
POP Configuration
CORE
Micro SD
Vflash
CORE
NOR Flash
I/O
CORE
DDR DRAM
Vcca
Vccb
3x Analog switch
XEARL, XEARR, HS
CORE
Headset driver
TPA4411
Vcc
Digital microphone
CORE
Audio amplifier
TPA2012D2
VBAT
I/O
GPS
Cost3.0
COVER
CORE
Ambient Light Sensor
VANA
VDIG
Videoconf. camera
Acme
I/O
CORE
VLED
PDA display
Monaco
I/O
CORE
VLED
CMT display
Wallstreet2
VLED
Cover keyboard
Backlight
VBAT
CORE
VDIG
IR module
1.15Mbps
VFMRAD
I/O
BT/FM Radio
BTHFM1
TK63128
2.8V
BT osc
CORE
Hall Sensor
Cover
CORE
QWERTY
Keyboard Controller COP8
I/O
CORE
DAC
Display accelerator
Hailstorm
Vcc
2x Dual analog switch
for CCP lines
Vccb
Vcca
Level shifter
for CCP
VDIG
VANA
VBAT
3MPix camera
Piranha
VANA
CORE
I/O
Camera accelerator
Goldeneye
CORE+I/O
SDRAM
for Goldeneye
Vcc
Tri-state buffer
for Goldeneye
Vcc
Dual buffer
for USB
Vcc
Dual buffer
Clkreq + Sleepclk
I/O
VBAT
WLAN
Gen2.5

Figure 36 Power distribution diagram

Power supply components:

- EM ASIC N2200
- EM ASIC N2300
- EM ASIC N4200
- Application processor VCORE_APE, VIO_APE N4200
- WLAN module supplies: N5501, N5502 and N5503
- Camera supplies: N8901, N8902 and N8903
- Mini SD regulator: N4200 VMMC_APE
- Flash LED driver: D8940

All the above are powered by the main battery voltage.

Battery voltage is also used on the RF side for power amplifiers (GSM PA & WCDMA PA) and for RF ASICs.

Discrete power supplies are used to generate 2.8 V to BT, 3.0 V for the camera voltage, 1.05/1.4 V for the application processor and 18 V for the backlight LEDs. The device supports both 1.8 V/3 V SIM cards which are powered by VSIM1.

USB accessories which need power from the device are powered by N2300 / VOUT.

The external LED driver (N2310) is used in this engine implementation.

System power-up

After inserting the main battery, regulators started by HW are enabled. SW checks, if there is some reason to keep the power on. If not, the system is set to power off state by watchdog. Power up can be caused by the following reasons:

- Power key is pressed
- Charger is connected
- RTC alarm occurs
- MBUS wake-up

After that:

- N2200 activates sleep clock and VANA, VDRAM, VIO and VR1 regulators.
- Voltage appearing at N2200 RSTX pin is used for enabling N2300 ASIC.
- N2300 enables VCORE regulator and its internal RC-oscillator (600 kHz).
- VCTCXO regulator is set ON and RF clock (main system clock) is started to produce.
- N2200 will release PURX ~ 16ms after power up is enabled (the RF clock is then stable enough).
- Synchronizing clock (2.4MHz) for N2300 is started to be produced. After PURX is released and two rising edges of 2.4 MHz synchronous clock have been detected in SMPSClk input N2300 is starting to use that instead of 600kHz internal RC-oscillator.
- HW start-up procedure has been finalized and the system is up and running. Now it is possible for SW to switch ON other needed regulators.

Clocking scheme

There are two main clocks in the system: 38.4 MHz RF clock produced by VCTCXO in RF section and 32.768 kHz sleep clock produced by the EM ASIC N2200 with an external crystal.

RF clock is generated only when VCTCXO is powered on by the EM ASIC regulator. Regulator itself is activated by SleepX signals from both RAP and application processor. When both CPUs are on sleep, RF clock is stopped.

RF clock is used by RAP, which provides (divided) 19.2 MHz SysClk further to the application processor. Both RAP and the application processor have internal PLLs which then create clock signals for other peripheral devices/interfaces like RS MMC, SIM, CCP, I2C and memories.

32k Sleep Clock is always powered on after startup. Sleep clock is used by RAP and the application processor for low-power operation.

SMPS Clk is 2.4 MHz clock line from RAP to EM ASIC N2300 used for switch mode regulator synchronizing in active mode. In deep sleep mode, when VCTCXO is off, this signal is set to '0'-state.

BT Clk is 38.4 MHz signal from the RF ASIC to the Bluetooth system.

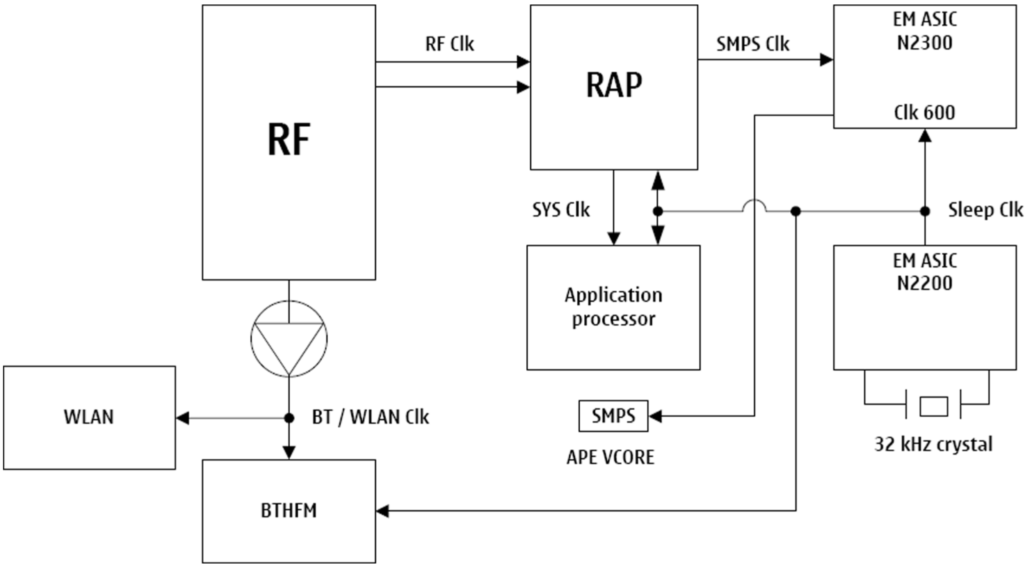

RF Clk
RAP
SMPS Clk
EM ASIC
N2300
Clk 600
RF
SYS Clk
Sleep Clk
Application processor
EM ASIC
N2200
WLAN
BT / WLAN Clk
SMPS
APE VCORE
32 kHz crystal
BTHFM

Figure 37 Clocking scheme

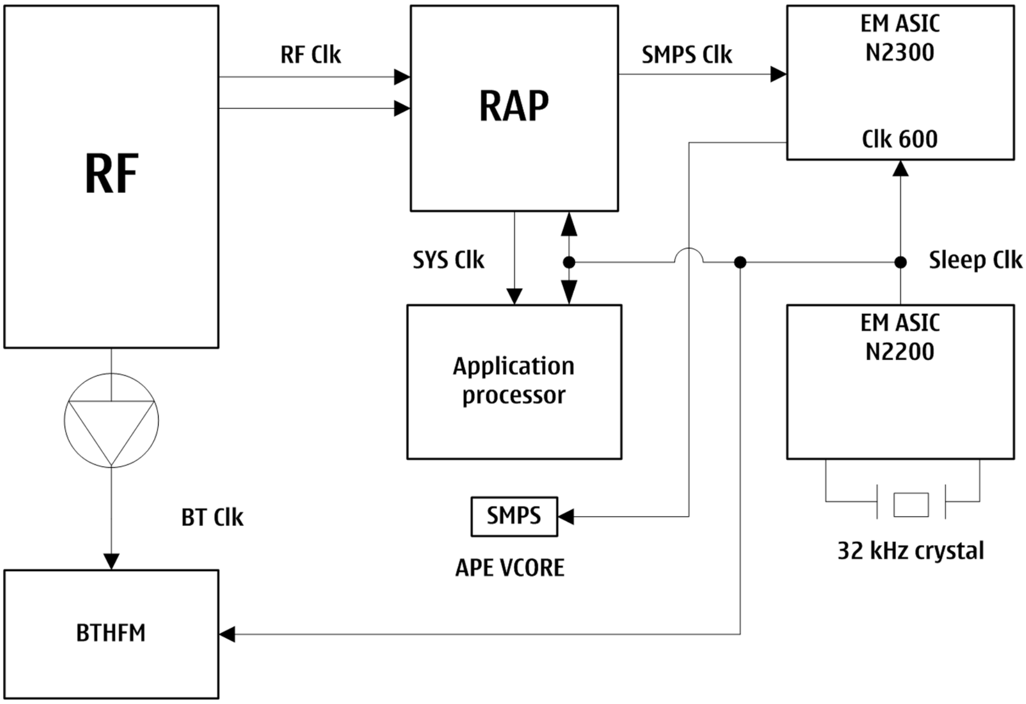

RF Clk
RAP
SMPS Clk
EM ASIC
N2300
Clk 600
RF
SYS Clk
Sleep Clk
Application processor
EM ASIC
N2200
BT Clk
SMPS
APE VCORE
32 kHz crystal
BTHFM

Figure 38 Clocking scheme

Bluetooth/FM module

The device has a module version of Bluetooth, in which BT and FM radio solutions are combined to a single BTHFM module. The module includes all external components except the antenna. However, the two solutions are electrically isolated from one another.

Bluetooth

Bluetooth is an open specification for wireless communication of data and voice. It is based on a low-cost short-range radio link between two or more devices. The traditional example is a link between a mobile phone and a laptop computer or a headset.

Bluetooth provides a fully digital link for communication between a master unit and one or more slave units. The system provides a radio link that offers a high degree of flexibility to support various applications and product scenarios. Data and control interface for a low power RF module is provided. The data rate is regulated between the master and the slave.

The device Bluetooth is based on the BC4 BT ASIC (BTHFM1.0).

The UART1 interface handles the transfer of control and data information between the application processor and the Bluetooth system. The PCM interface is used for audio data transfer between the RAP ASIC and the Bluetooth system.

FM radio

The second part of the BTHFM module contains the FM radio.

The antenna for the FM radio is provided by plugging in an external wired headset to the system connector. It is not possible to listen to the FM radio without a wired headset connected. The FM radio is controlled by I2C commands coming from RAP. The audio output of the FM radio is fed to the headset via the EM ASIC N2200, so the rest of the phone can sleep while the FM radio is active.

USB

USB (Universal Serial Bus) provides a wired connectivity between a USB host PC and peripheral devices.

USB is a differential serial bus for USB devices. USB controller supports USB specification revision 2.0 with full speed USB (12 Mbps). The device is connected to the USB host through the system connector. The USB bus is hot plugged capable, which means that USB devices may be plugged in/out at any time.

WLAN interface

A Wireless Local Area Network (WLAN) is a flexible data communication system in which a mobile user can connect to a local area network through a wireless connection. The standard, which specifies the technologies for WLAN, is called IEEE 802.11. The device supports both IEEE 802.11.b and 802.11.g standards, so the support data rates are from 1 Mbps to 54 Mbps in 2.4 GHz ISM band.

The WLAN module also requires the reference clock of 38.4 MHz.

The WLAN module uses the same VIO as the application processor.

The same antenna is shared with BT and WLAN. When BT_CLK_REQ is activated and WLANENABLE is disabled, the antenna can be used by BT.

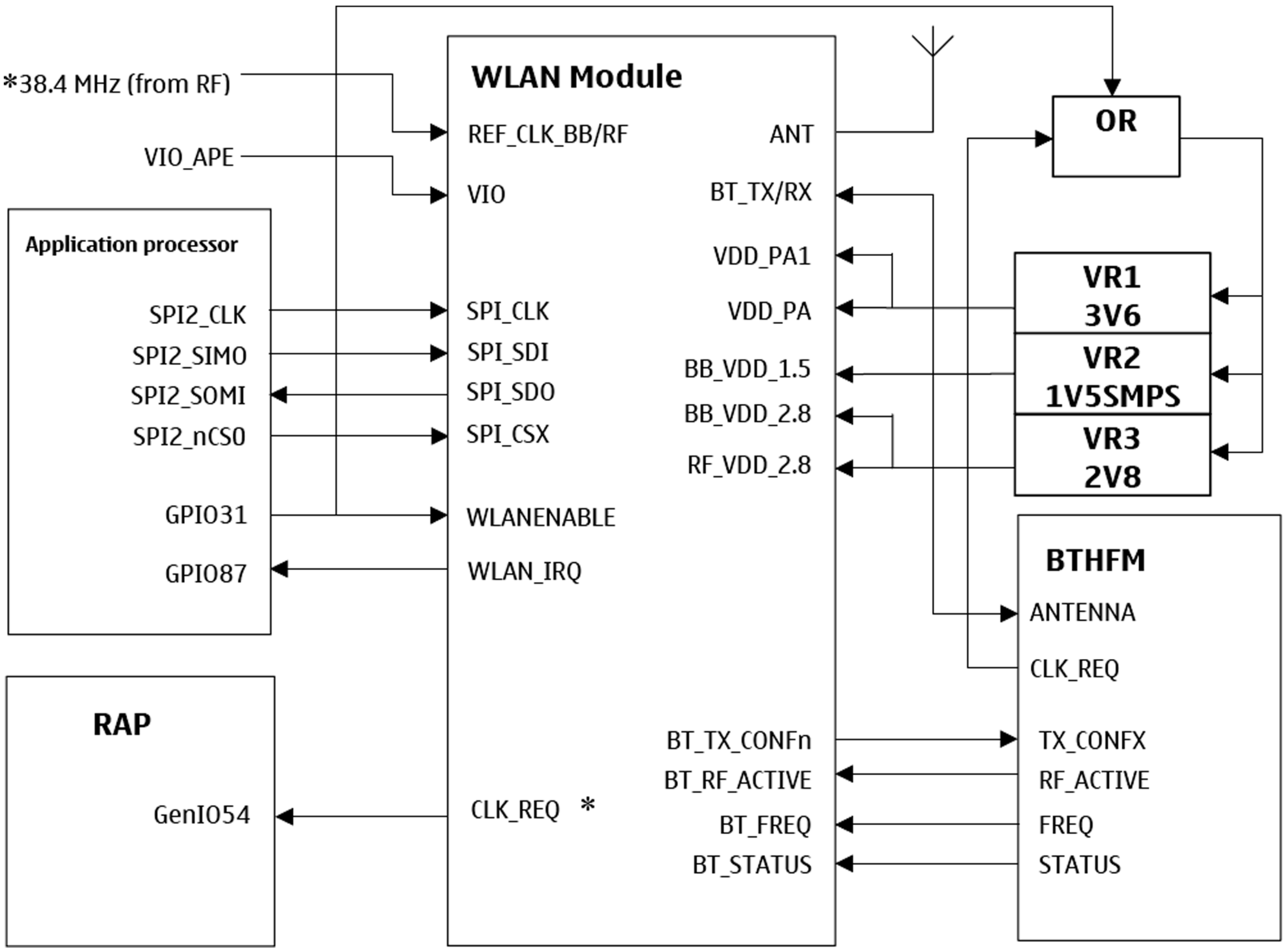

*38.4 MHz (from RF)
VIO_APE
WLAN Module
REF_CLK_BB/RF
VIO
ANT
BT_TX/RX
VDD_PA1
VDD_PA
BB_VDD_1.5
BB_VDD_2.8
RF_VDD_2.8
OR
VR1
3V6
VR2
1V5SMPS
VR3
2V8
Application processor
SPI2_CLK
SPI2_SIMO
SPI2_SOMI
SPI2_nCS0
GPIO31
GPIO87
SPI_CLK
SPI_SDI
SPI_SDO
SPI_CSX
WLANENABLE
WLAN_IRQ
BTHFM
ANTENNA
CLK_REQ
RAP
GenIO54
CLK_REQ *
BT_TX_CONFn
BT_RF_ACTIVE
BT_FREQ
BT_STATUS
TX_CONFX
RF_ACTIVE
FREQ
STATUS

Figure 39 WLAN block diagram

Irda interface

IrDA specifies a low-cost, reliable, fully digital peer-to-peer data link between IrDA units at data rates to 115.2k bits/s. The link is based on the serial transmission of data as pulses of infrared light at the wave length of 870 nm and angles of +-15 degrees at the range 0 - 50 to 100 cm. Because these restrictions and the optical nature of the link, the transmission is not omnidirectional but focused, and only reaches a peer at a limited line-of-sight distance from the transmitter. Therefore, the transmission does not disturb any other units in the neighbourhood.

The IR interface is implemented into the application processor. The processor block uses the UART3 circuit to communicate with a standard IrDA transceiver. The IR transceiver module complies with the IrDA specification version 1.4. The data rates are in the range of 9600 bit/s to 115200 bits/s.

The IR interface in the application processor and the IR transceiver module use the I/O voltage 1.8 V on the Rx (processor receive), Tx (processor send), and SD (IR module shutdown) pins. The IR transmission is powered from the phone battery VBAT (nominal 3.7 V) through a load resistor.

IR communication is half-duplex, meaning that the IR receiver sees its own transmission, and the IR interface is either transmitting or receiving, but not both at the same time. IrDa modules consume current when the IR detector is active.

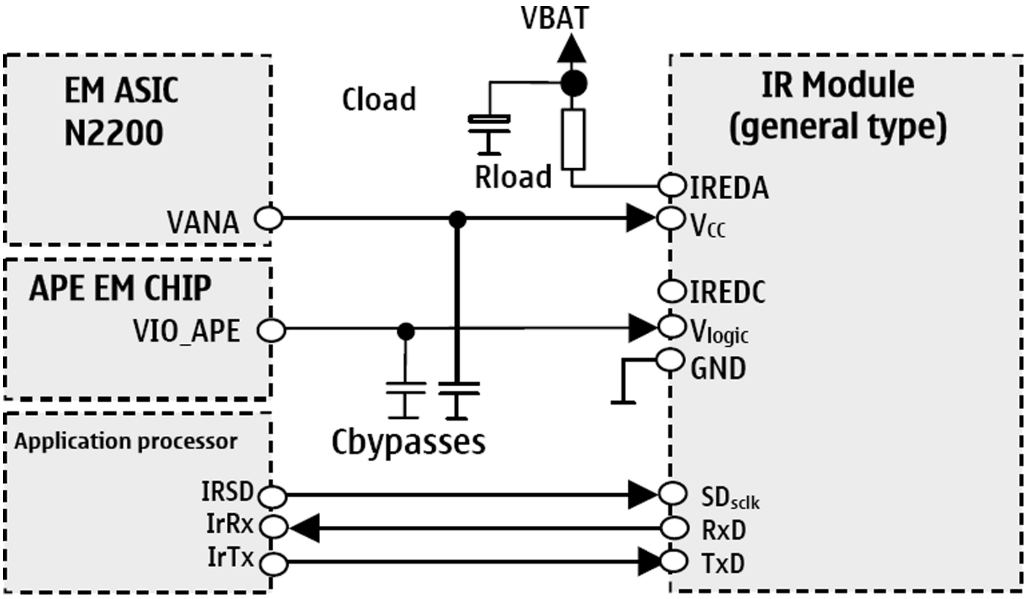
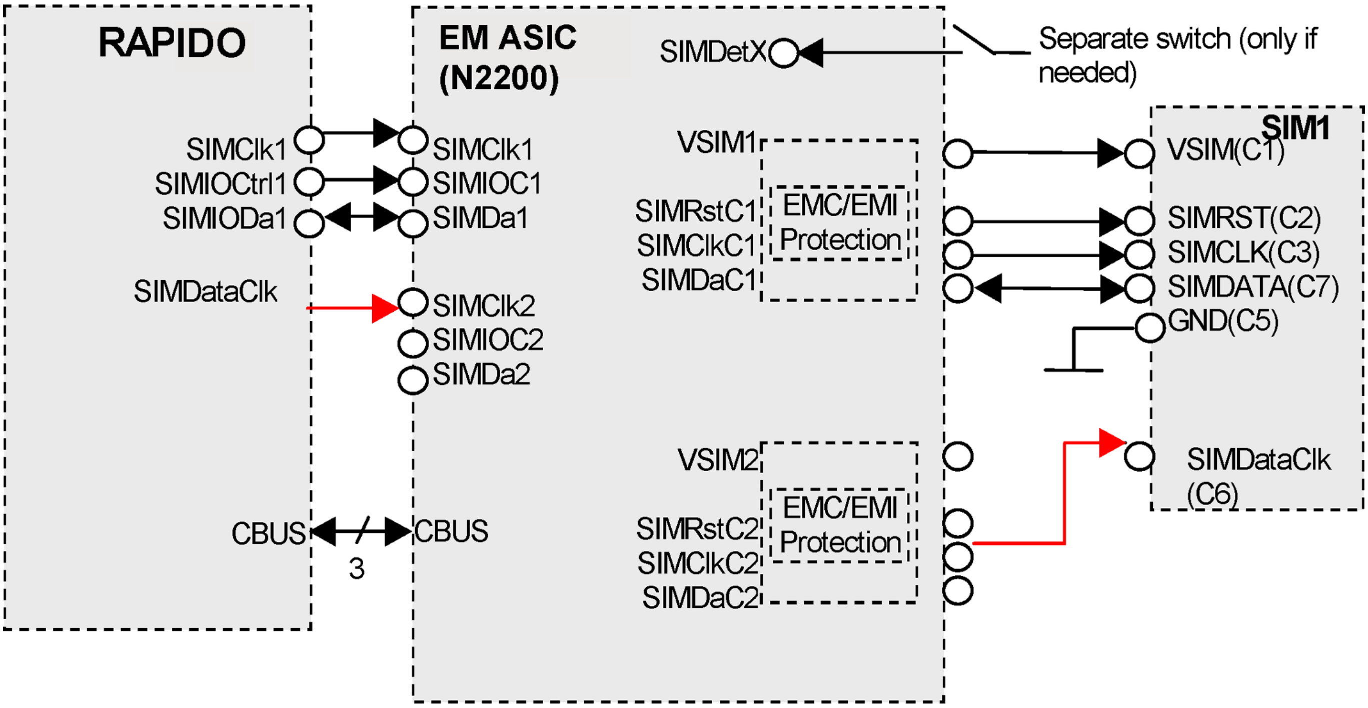

VBAT
EM ASIC
N2200
VANA
Cload
Rload
IR Module
(general type)
IREDA
Vcc
APE EM CHIP
VIO_APE
IREDC
Vlogic
GND
Cbypasses
Application processor
IRSD
IrRx
IrTx
SDsclk
RxD
TxD

Figure 40 Interconnections between application processor, EM ASICs, and IR module

SIM interface

The device has one SIM (Subscriber Identification Module) interface. The interface is located in two ASICs; digital ASIC RAP contains most of the interface functionality and the mixed signal EM ASIC (N2200) takes care of power up/down, card detect, ATR counting and level shifting.

The SIM IF is shown in the following figure:


RAPIDO
SIMClk1
SIMIOCtrl1
SIMIODa1
SIMDataClk
CBUS
3
EM ASIC
(N2200)
SIMClk1
SIMIOC1
SIMDa1
SIMClk2
SIMIOC2
SIMDa2
CBUS
SIMDetX
VSIM1
SIMRstC1
SIMClkC1
SIMDaC1
EMC/EMI
Protection
VSIM2
SIMRstC2
SIMClkC2
SIMDaC2
EMC/EMI
Protection
Separate switch (only if needed)
SIM1
VSIM(C1)
SIMRST(C2)
SIMCLK(C3)
SIMDATA(C7)
GND(C5)
SIMDataClk
(C6)

When smart card is inserted the supplied voltage is first 1.8V. If the card does not answer with the ATR (answer to reset) the next higher class is applied. Only 1.8V and 3V cards are supported.

EM ASIC (N2200) handles the smart card detection. Smart cards are located behind battery and the removal of the battery causes quick power down of the cards.

SD card interface

The SD card connector is mounted on the user interface PWB. The SD card is supplied with 3 V supply voltage. The detection of the SD card removal/insertion is done by a switch in the card connector. Removing the SD card while writing to the card may corrupt data in the SD card.

GPS interface

The device includes an inbuilt GPS receiver and it works as a stand-alone positioning device. The antenna is located below the main keypad in the bottom of the product.

The GPS system is connected to RAPIDO ASIC.

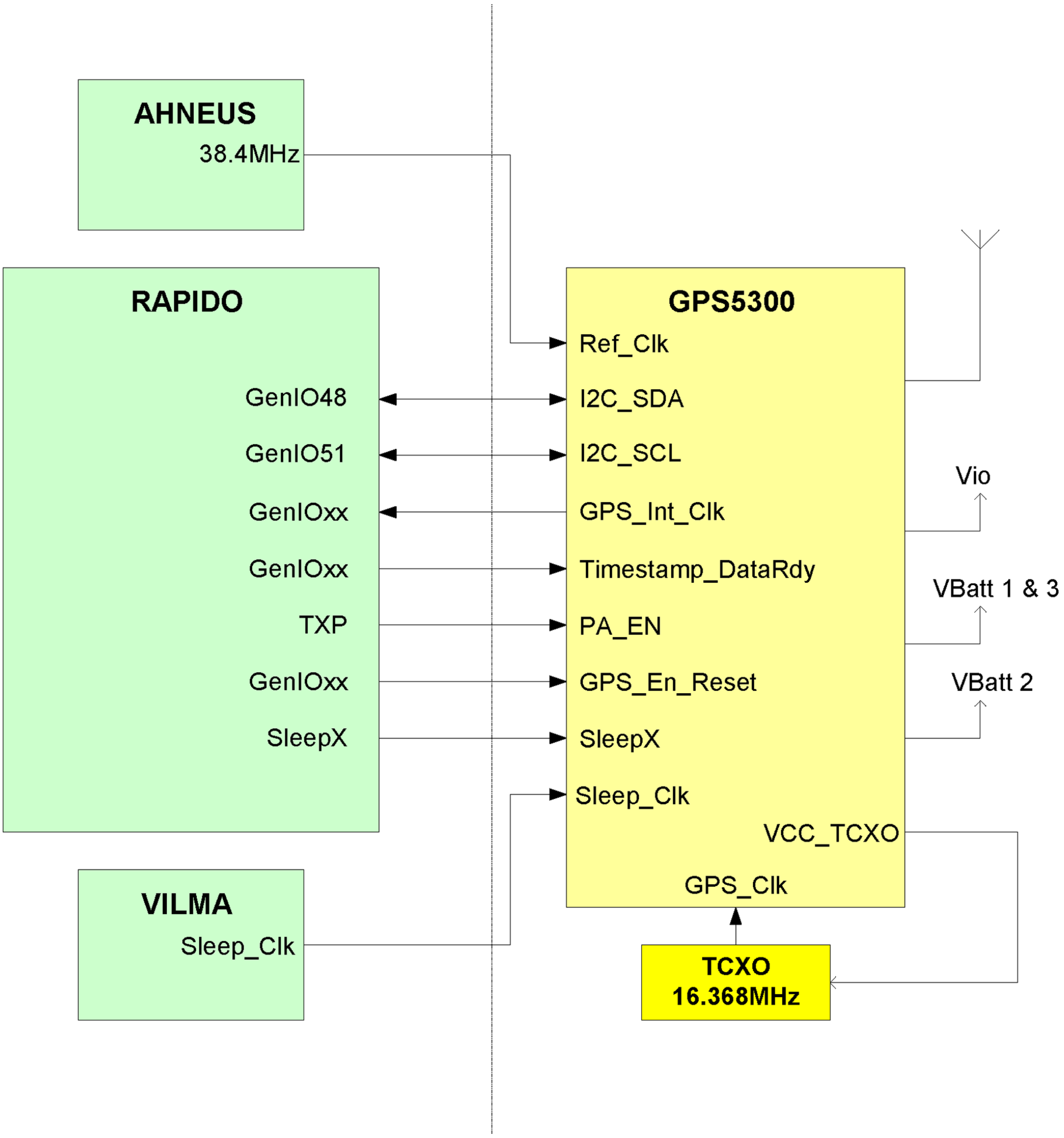

AHNEUS
38.4MHz
RAPIDO
GenIO48
GenIO51
GenIOxx
GenIOxx
TXP
GenIOxx
SleepX
VILMA
Sleep_Clk
GPS5300
Ref_Clk
I2C_SDA
I2C_SCL
GPS_Int_Clk
Timestamp_DataRdy
PA_EN
GPS_En_Reset
SleepX
Sleep_Clk
VCC_TCXO
GPS_Clk
Vio
VBatt 1 & 3
VBatt 2
TCXO
16.368MHz

Figure 41 Block diagram of the GPS system

Battery interface

The phone is powered by a 3-pole BL-5F battery. The three poles are named VBAT, BSI and GND where the BSI line is used to recognize the battery capacity. This is done by means of an internal battery pull down resistor.

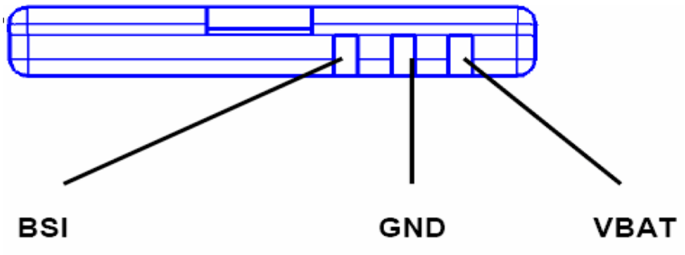

BSI
GND
VBAT

Figure 42 Battery pin order

Battery temperature is estimated by measuring separate battery temperature NTC via the BTEMP line, which is located on the main PWB, at a place where the phone temperature is most stabile.

The connection from the charger connector to the charger is established via a charger adaptor.

For service purposes, the device software can be forced into local mode by using pull down resistors connected to the BSI line.

Camera system

The device's camera system consists of camera processor, which is connected to the application processor. The camera processor has external SDRAM and it used N5452 IC to control AF and mechanical shutter. The main camera and flash driver is connected to the camera processor. The front camera (second camera) is connected to application processor and it shares the CCP-bus with the camera processor through switches N5400 and 5401.

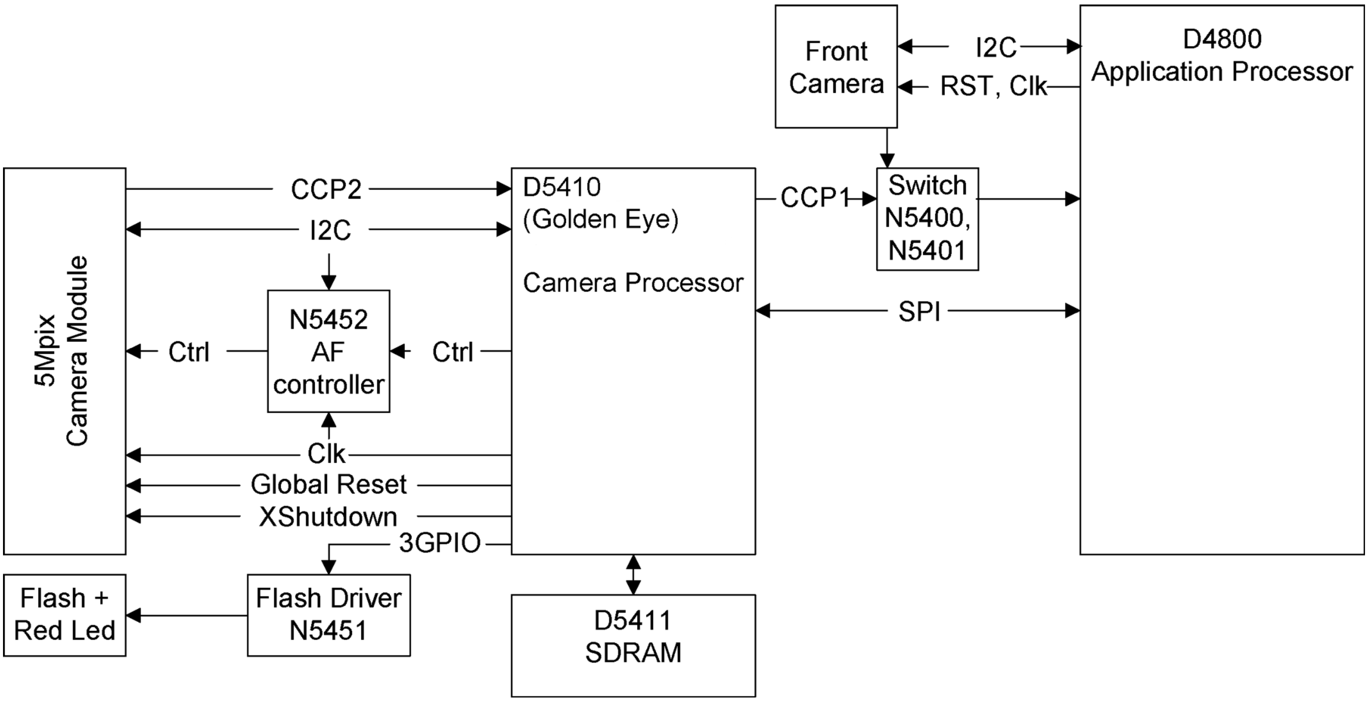

Front Camera
I2C
RST, Clk
D4800 Application Processor
5Mpix Camera Module
CCP2
I2C
D5410 (Golden Eye)
Camera Processor
CCP1
Switch N5400, N5401
SPI
N5452 AF controller
Ctrl
Ctrl
Clk
Global Reset
XShutdown
3GPIO
Flash + Red Led
Flash Driver N5451
D5411 SDRAM

Figure 43 Camera system block diagram

Camera characteristics

Main camera characteristics

Sensor type	CMOS
Sensor photo detectors	5.0 million (2592 x 1944 pixels)
F number/Aperture	f/2.8
Focal length	5.6/35 mm (35 mm equal)
Focus range	10 cm to infinity
Still Image resolutions	up to 5 Megapixel: 2592x1944
Still images file format	EXIF (JPEG), *.jpg
Video resolutions	VGA 640 x 480 at 30 fps/15 fps 320 x 240 (QVGA) at 30/15 fps 176 x 144 at 15 fps (QCIF)
Video clip length	Maximal clip length is 60 mins (High or Normal quality) or limited to MMS size approx. 30 seconds (Sharing quality) **Note:** Clip length is dependable on available memory
Video file format	.mp4 (default) and .3gp (for MMS)
Auto exposure	Center weighted AE
White balance	Automatic, sunny, cloudy, incandescent, flurescent
Colour tones	Normal, sepia, vivid, black&white, negative
Capture Modes	Still capture mode, video mode and sequence mode
Selftimer	2, 10, or 20 secs
Flash settings	Auto, off, forced, anti red-eye
Automatic image rotation	On / Off

Flash LED

The device back camera has a flash LED (FLED) located directly beside the camera, providing better lighting conditions in darker environments. The same LED is also used as an indicator light to indicate video clip recording, and to indicate when pictures are being taken as a privacy indicator.

The connections between the main PWB and the FLED are implemented with a pair of “pogo” pins shown as X6501 on the schematic.

The FLED has four white LEDs connected in series in one module. The module also includes a lens with its plastic housing to ensure a proper light pattern at the target.

The dimensions of the FLED are 6.5 x 7.5 x 3.5 mm.

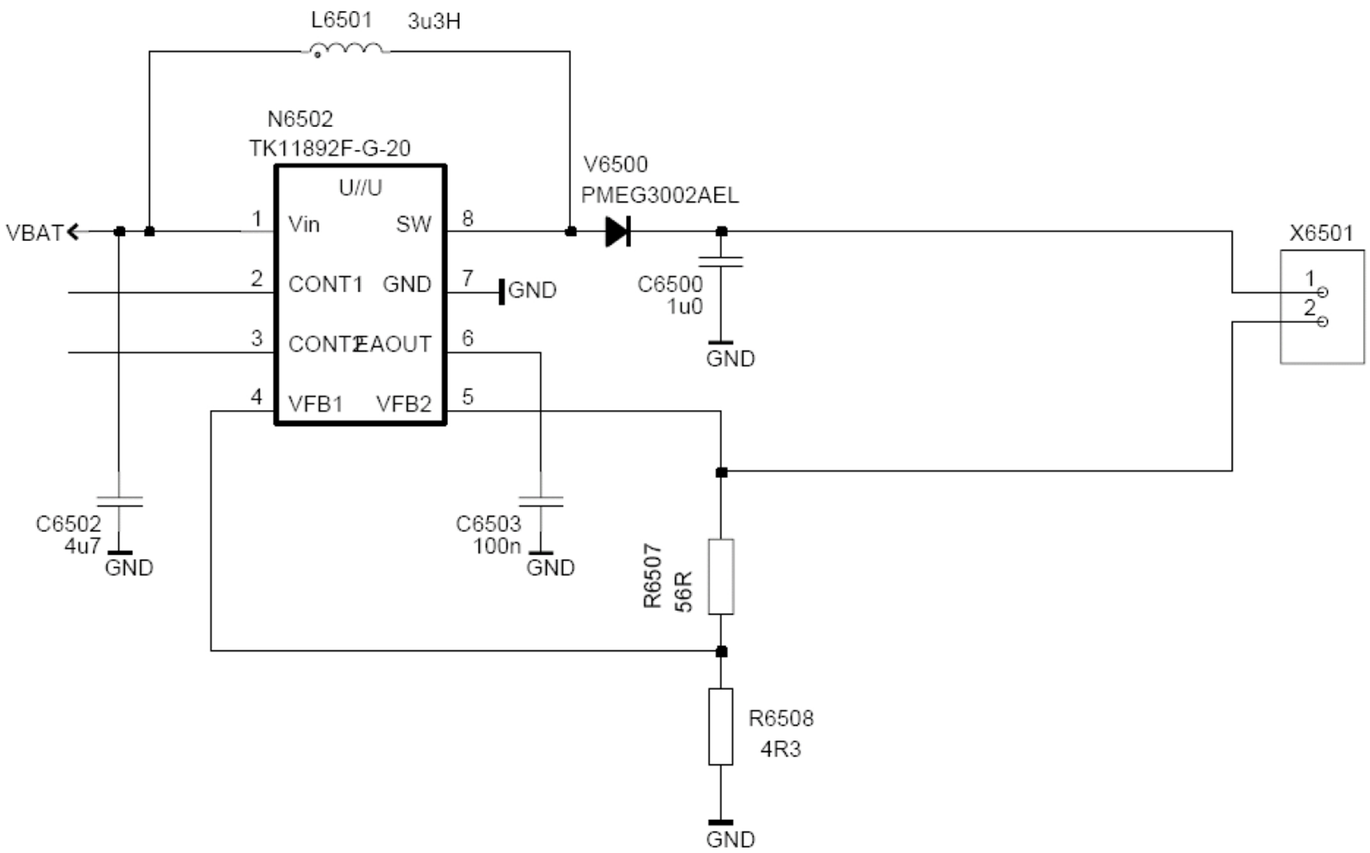

L6501
3u3H
N6502
TK11892F-G-20
U//U
VBAT
1
Vin
SW
8
2
CONT1
GND
7
GND
3
CONT2
EAOUT
6
4
VFB1
VFB2
5
V6500
PMEG3002AEL
C6500
1u0
GND
X6501
1
2
C6502
4u7
GND
C6503
100n
GND
R6507
56R
R6508
4R3
GND

Figure 44 Simplified flash LED connection

Secondary camera characteristics

Sensor type	CMOS
Sensor Photo detectors	CIF
F number/Aperture	f/2.8
Focal length	43 mm (35mm equivalent)
Focus range	10 cm to infinity
Still Image resolutions	QVGA
Still images file format	JPEG/EXIF

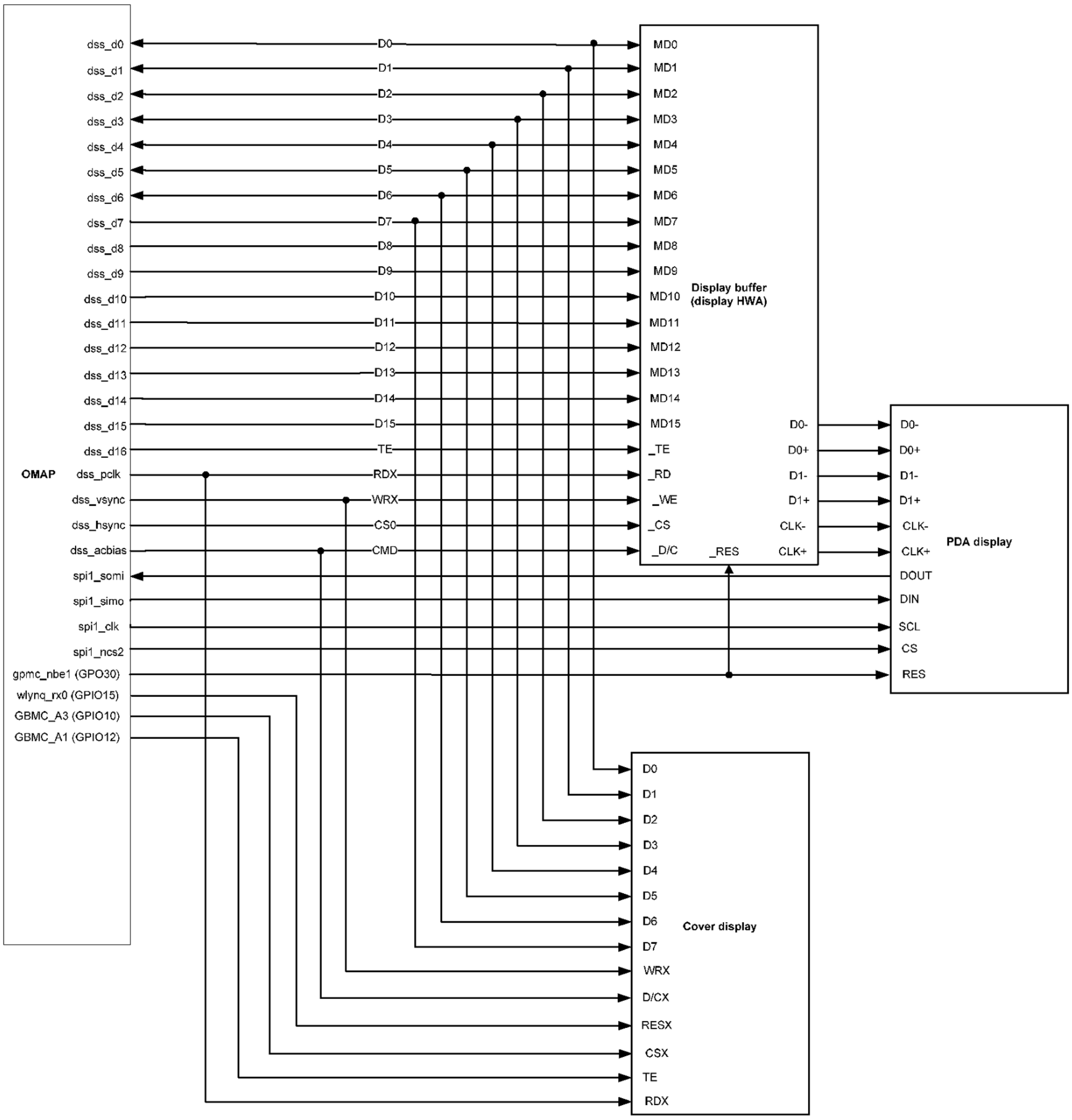
User interface

Display interfaces

MeSSI output from application processor is multiplexed to display buffer and to cover display.

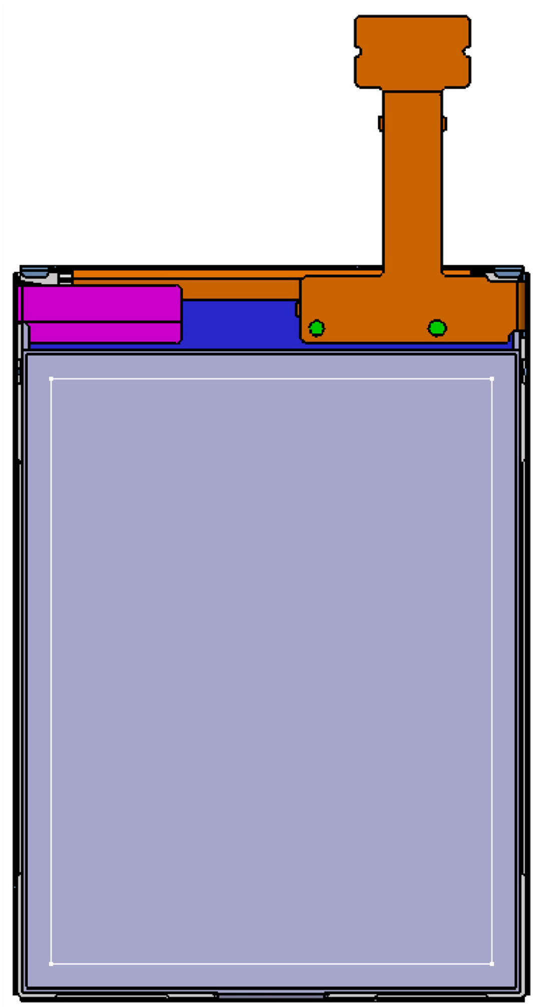
Display buffer has 16-bit wide data bus and cover display uses 8 first bits of these. Chip selects are used to control data flow between display buffer and cover display.

Display buffer has a CDP transmitter that converts MeSSI image data to CDP format which is routed through hinge and through 1NP UI-FPC to PDA display. SPI1 bus in application processor is connected to PDA display LoSSI input. LoSSI is a command interface for PDA display.


OMAP
dss_d0
dss_d1
dss_d2
dss_d3
dss_d4
dss_d5
dss_d6
dss_d7
dss_d8
dss_d9
dss_d10
dss_d11
dss_d12
dss_d13
dss_d14
dss_d15
dss_d16
dss_pclk
dss_vsync
dss_hsync
dss_acbias
spi1_somi
spi1_simo
spi1_clk
spi1_ncs2
gpmc_nbe1 (GPO30)
wlynq_rx0 (GPIO15)
GBMC_A3 (GPIO10)
GBMC_A1 (GPIO12)
D0
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
TE
RDX
WRX
CS0
CMD
Display buffer
(display HWA)
MD0
MD1
MD2
MD3
MD4
MD5
MD6
MD7
MD8
MD9
MD10
MD11
MD12
MD13
MD14
MD15
_TE
_RD
_WE
_CS
_D/C
_RES
D0-
D0+
D1-
D1+
CLK-
CLK+
PDA display
D0-
D0+
D1-
D1+
CLK-
CLK+
DOUT
DIN
SCL
CS
RES
Cover display
D0
D1
D2
D3
D4
D5
D6
D7
WRX
D/CX
RESX
CSX
TE
RDX

Main display

Display module mechanical concept



Display features:

- Module size (width x height x thickness) 35.8 mm,51.2 mm, 2.215 mm
- Resolution QVGA (240*320)
- Numbers of colours up to 16.7M
- Partial display function; power saving by pausing display process on part of the screen.
- Built-in RAM capacity 240 columns x 320 rows x 24 bits

The display has two different operating modes:

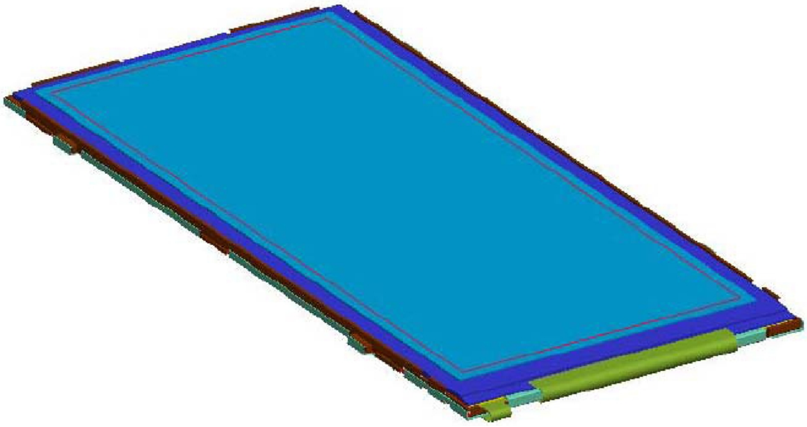
- Normal mode, Full screen, 16.7M colors
- Partial idle mode, 8 colours but only part of the display is active

The display is located in the cover part. The interconnection between the LCD module and the 1NP UI-FPC is implemented with a 24-pin board-to-board connector.

The display is controlled via MeSSi-8 interface with an 8-bit bus by the application processor. All MeSSi signals go through the EMC filtering ASIPs (Z4600 and Z4601).

The display module does not require any tunings in service.

PDA display



Display features:

- Module size (width x height x thickness) 102.3mm x 49.044mm x 2.12mm (across panel) 3.9mm (across connector)
- Resolution 800*352
- Numbers of colours up to 16.7M
- 1 pixel data memory (24 bit)
- Transflective optics, normal black

The display has two different interfaces:

- CDP (Compact Display Port) interface for data transmission. CDP is a high speed serial interface with differential clock channel and two differential data channels (total 6 wires). CDP is connected to Hailstorm display buffer (D5600) that is located on system/ RF module. CDP signals go through common mode filters Z5600, Z5601 and Z5602.
- LoSSI (Low Speed Screen Interface) for command/parameter transfer. LoSSI is a 9-bit serial interface connected to the application processor. LoSSI signal go through the EMC filtering ASIP Z4503.

The display is located in the cover part. The interconnection between the LCD module and the 1NP UI-FPC is implemented with a 24-pin board-to-board connector.

The display module does not require any tunings in service.

Display buffer

Display buffer S1D13745 (D5600) and needed peripheral components are located on system/ RF module. It is used as a data buffer between engine and PDA display. It converts MeSSI image data to CDP format which is routed to PDA display.

S1D13745 display buffer features:

- Input bus is 8/16-bit Intel 80 interface MeSSI
- Output is High Speed Serial Interface (HiSSI) supported with 1/2-channel up to 450 Mbps per channel or 3-channel up to 650 Mbps per channel
- 1280K byte display buffer and supports 24 bpp display modes
- Resolutions are supported up to 856x480. Resolutions and frame-rates are completely programmable

Keyboards

The device has two separate keyboards:

- Cover keyboard (S60 keyboard)
- PDA keyboard

Cover keyboard

Cover keyboard domes are assembled on 1NP UI-FLEX. Keyboard matrix consists also SEND, END and two SW keys that are located on both sides of PDA display.

1NP UI-FLEX is assembled to the chassis part of phone. If there's failure on these parts, whole chassis assy has to be replaced.

Table 9 Cover keyboard matrix

	Col 0	Col 1	Col 2	Col 3
Row 0		UP	RIGHT	LEFT SK
Row 1	SELECT	CLEAR	DOWN	SEND
Row 2	END	3	2	APPS
Row 3	6	9	8	LEFT
Row 4	#	RIGHT SK	5	1
Row 5	*	0	7	4
Row 6	CBA1 (Send)	CBA2 (End)	CBA3 (SW key)	CBA4 (SW key)

- Col 0-3 and Row 0-6 are filtered with ASIP Z4502.
- Power key is also placed on the UI FPC module 1NP. It connected directly to EM ASIC N2200 PWRONX PIN

PDA keyboard

PDA keyboard pads are placed directly on the system/RF module. System/RF module includes also side keys (volume keys and 2-position camera key).

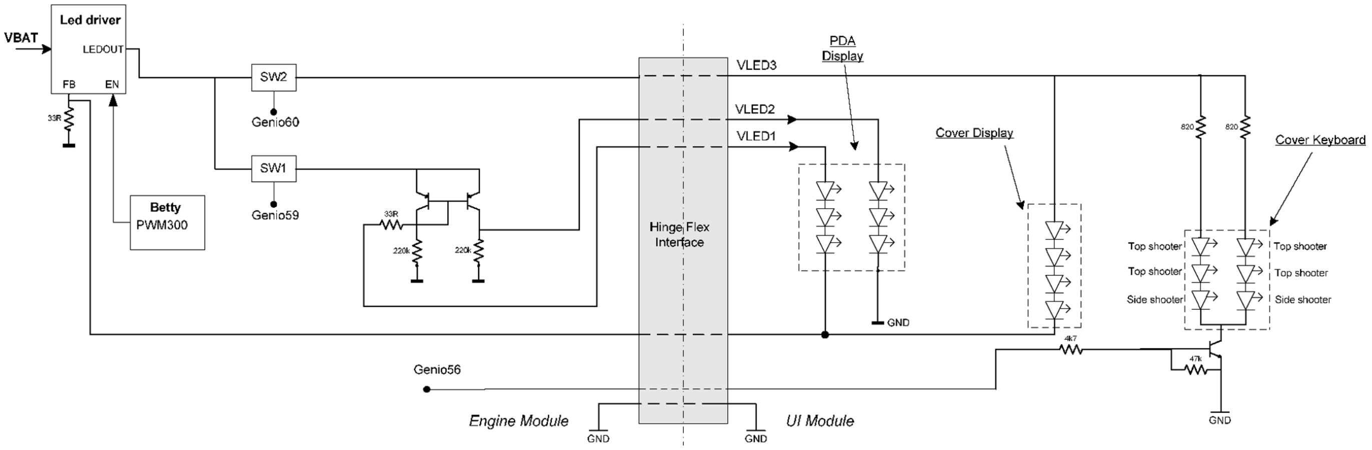
Display and keyboard backlights

The device uses SMPS LED driver to drive cover display, PDA display and cover keyboard LED's.

- In cover display, there is four white LED´s connected in series (LED´s are located in display module)
- In PDA display, there is 3 + 3 white LED´s connected in series (LED´s are located in display module)
- Current mirror is controlling that equal current is flown in both branches
- In cover keyboard, there is 3+3 leds connected in series (LED´s are located in UI-FPC 1NP)

Display LED brightness can be controlled with PWM signal (0-100%, ~293Hz). Cover keyboard LEDs can be turned OFF separately.

In PDA keyboard there is EL (electroluminescent) lamp used. Needed EL driver (N4400) and related components are located on system/ RF module.


VBAT
Led driver
LEDOUT
FB
EN
33R
SW2
Genio60
SW1
Genio59
Betty
PWM300
33R
220k
220k
Hinge Flex Interface
VLED3
VLED2
VLED1
PDA Display
Cover Display
820
820
Cover Keyboard
Top shooter
Top shooter
Side shooter
Top shooter
Top shooter
Side shooter
GND
4k7
47k
GND
Genio56
Engine Module
UI Module
GND
GND

ALS interface

Ambient Light Sensor consists following components:

- Lightguide (part of A-cover)
- Ambient Light Sensor (ALS). ALS is logarithmic, which response to light is similar to human eye. ALS is located on UI-FPC and it is not a spare part
- Analog switch N4503, to turn on operating voltage VAUX to ALS only when needed (located on system/ RF module)
- Pull-down resistor R4505 to convert current signal to voltage (located on system/ RF module)

Ambient Light Sensor information is used to control cover backlights of the phone. Cover keyboard backlight is turned OFF, when they are not needed.

Cover display backlight is dimmed, when environment lighting is dark. Ambient Light Sensor is calibrated in production. In service points, calibration is not possible.

ASICs

RAP ASIC

RAP ASIC is a 3G Radio Application Processor. RAM memory is integrated into RAP.

EM ASIC N2300

The EM ASIC (N2300) includes the following functional blocks:

- Core supply generation
- Charge control circuitry
- Level shifter and regulator for USB/FBUS
- Current gauge for battery current measuring
- LED driver for backlights
- Digital interface (CBUS)

EM ASIC N2200

The EM ASIC (N2200) includes the following functional blocks:

- Start up logic and reset control
- Charger detection
- Battery voltage monitoring

- 32.768kHz clock with external crystal
- Real time clock with external backup battery
- SIM card interface
- Stereo audio codecs and amplifiers
- A/D converter
- Regulators
- Vibra interface
- Digital interface (CBUS)

Device memories

RAP memories NOR flash and SDRAM

Modem memory consists of 128 Mbit SDRAM and 128 Mbit NOR flash memories.

Combo memory

The application memory of the device consists of NAND/DDR combo memory. The stacked DDR/NAND application memory has 512 Mbit of DDR memory and 1024 Mbit of flash memory.

Audio concept

Audio HW architecture

The functional core of the audio hardware is built around two ASICs: RAP CMT engine ASIC and mixed-signal ASIC (N2200).

The mixed-signal ASIC (N2200) provides an interface for the transducers and the accessory connector. Because audio amplifiers are also integrated into the ASIC, the only discrete electronics components needed for audio paths are audio filtering components and EMC/ESD components.

There are three audio transducers:

- 8 mm dynamic earpiece
- 16 mm dynamic speaker
- two digital MEMS (Microelectromechanical Systems) microphones

In addition to the audio transducers, N2200 also provides an output for the dynamic vibra component.

All galvanic audio accessories are connected to the system connector.

A Bluetooth audio and FM radio module, which is connected to the RAP ASIC supports Bluetooth audio and FM radio functionality.

There is also a separate application ASIC for Symbian applications.

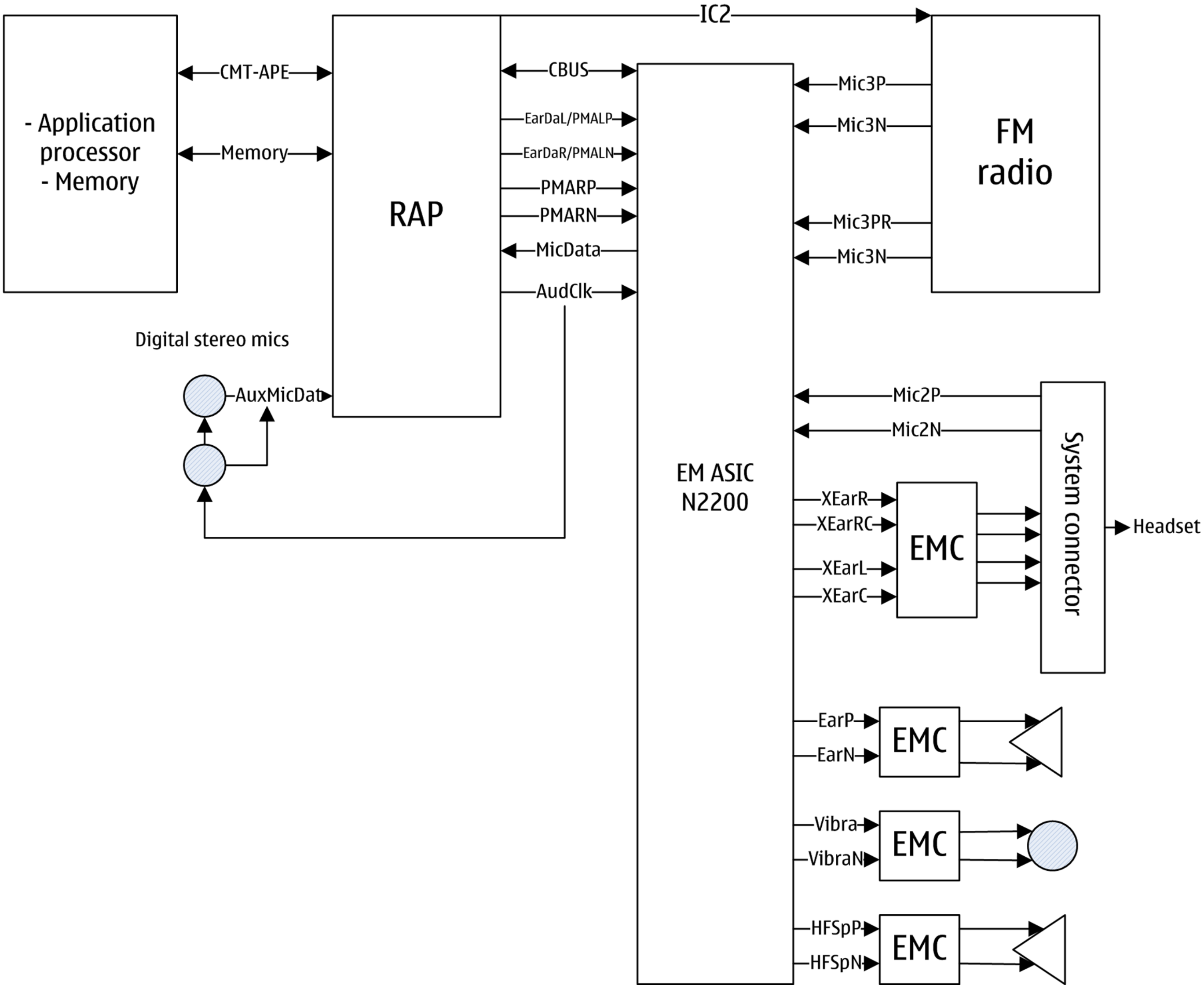

IC2
- Application processor
- Memory
CMT-APE
Memory
RAP
CBUS
EarDaL/PMALP
EarDaR/PMALN
PMARP
PMARN
MicData
AudClk
Digital stereo mics
AuxMicDat
EM ASIC
N2200
Mic3P
Mic3N
Mic3PR
Mic3N
FM radio
Mic2P
Mic2N
XEarR
XEarRC
XEarL
XEarC
EMC
System connector
Headset
EarP
EarN
EMC
Vibra
VibraN
EMC
HFSpP
HFSpN
EMC

Figure 45 Audio block diagram

Internal microphone

The internal microphone is used for HandPortable (HP) and Internal HandsFree (IHF) call modes, and camcorder stereo recording.

Two digital MEMS microphones are connected to the RAP ASIC (D2800) via an analogue switch IC (N2150). The microphone power and clock signals are controlled by this switch.

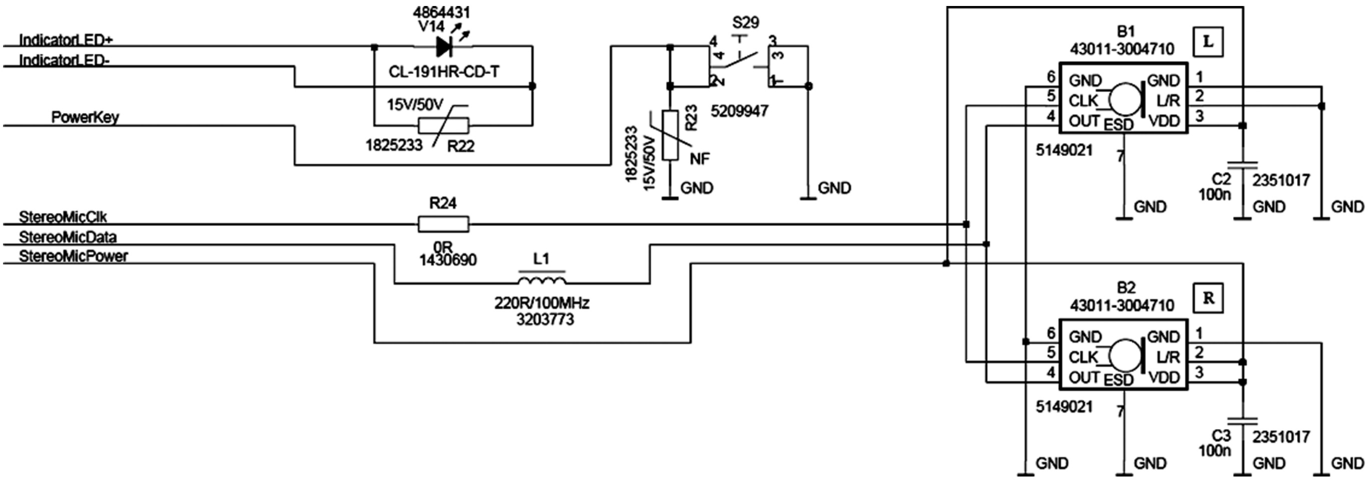

IndicatorLED+
IndicatorLED-
PowerKey
StereoMicClk
StereoMicData
StereoMicPower
4864431
V14
CL-191HR-CD-T
15V/50V
1825233
R22
R24
0R
1430690
L1
220R/100MHz
3203773
S29
5209947
R23
NF
GND
B1
43011-3004710
L
GND
CLK
OUT
ESD
L/R
VDD
5149021
C2
100n
2351017
B2
R
C3

Figure 46 Internal microphone circuitry in UI flex PWB

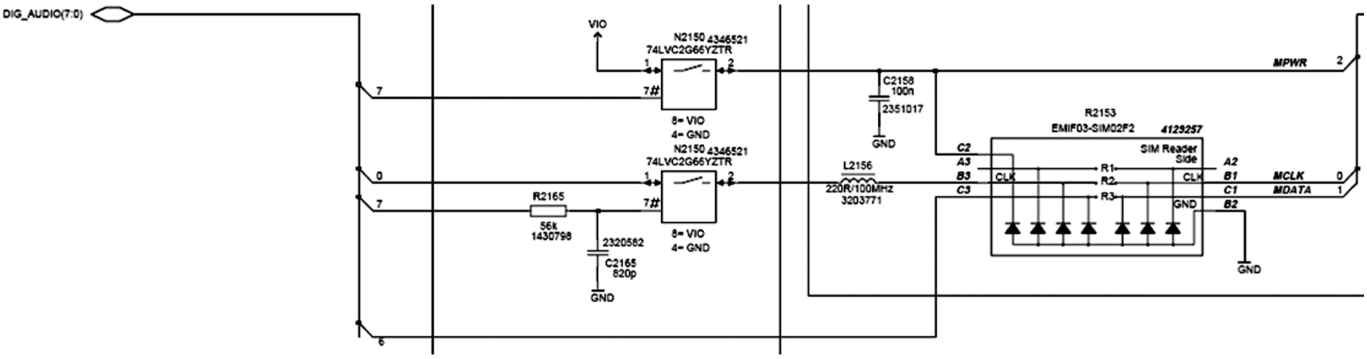

DIG_AUDIO(7:0)
VIO
N2150 4346521
74LVC2G66YZTR
8= VIO
4= GND
R2165
56k
1430798
2320582
C2165
820p
GND
C2158
100n
2351017
L2156
220R/100MHz
3203771
R2153
EMIF03-SIM02F2
4129257
SIM Reader Side
CLK
R1
R2
R3
C2
A3
B3
C3
A2
B1
C1
B2
MPWR
MCLK
MDATA

Figure 47 Internal microphone circuitry in engine PWB

External microphone

Galvanic accessories are connected to the system connector.

Accessory audio mode is automatically enabled/disabled during connection/disconnection of dedicated phone accessories.

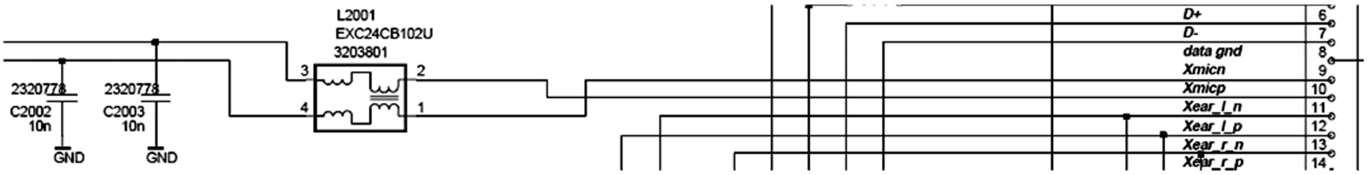

L2001
EXC24CB102U
3203801
2320778
C2002
10n
C2003
GND
D+
D-
data gnd
Xmicn
Xmicp
Xear_l_n
Xear_l_p
Xear_r_n
Xear_r_p

Figure 48 External microphone circuitry

Internal earpiece

The internal earpiece is used in the HandPortable (HP) call mode. A dynamic 8 mm earpiece capsule is connected directly to the EM ASIC (N2200) differential outputs EarP and EarN through the flip flexi PWB and micro coaxial cable (X6 - X8900).

Internal speaker

The internal speaker is used in Internal HandsFree (IHF) call mode.

A dynamic 16 mm speaker is connected to the EM ASIC (N2200) outputs HFSpP and HFSpN through the flip flexi PWB and micro coaxial cable (X6 - X8900).

The IHF amplifier integrated in N2200 is a Digital Pulse Modulated Amplifier (DPMA).

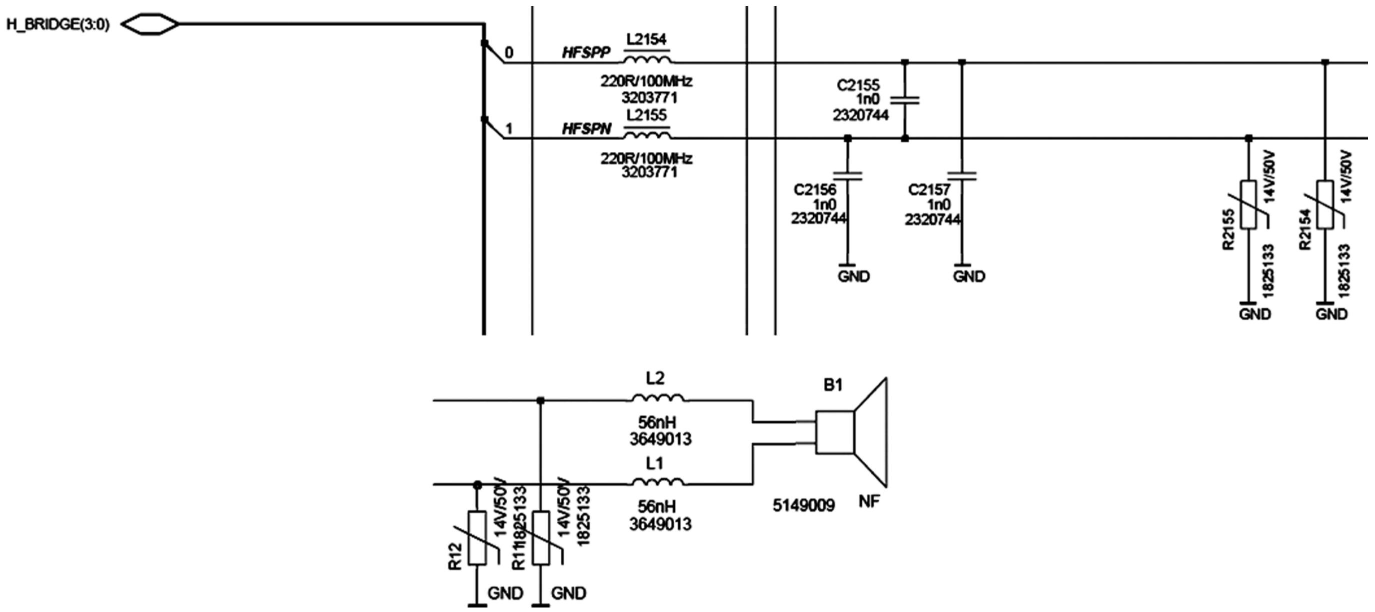

H_BRIDGE(3:0)
0
1
HFSPP
HFSPN
L2154
220R/100MHz
3203771
L2155
220R/100MHz
3203771
C2155
1n0
2320744
C2156
1n0
2320744
C2157
1n0
2320744
GND
GND
R2155
14V/50V
1825133
GND
R2154
14V/50V
1825133
GND
L2
56nH
3649013
L1
56nH
3649013
B1
5149009
NF
R12
14V/50V
R11
1825133
14V/50V
1825133
GND
GND

Figure 49 Internal speaker circuitry

External earpiece

All galvanic accessories are connected to the system connector.

The accessory audio mode is automatically enabled/disabled during connection/disconnection of dedicated phone accessories.

The EM ASIC (N2200) provides two output channels in either single-ended or differential format. N2200 outputs XearL and XearLC form the left channel audio output, and XearR and XearRC the right channel audio output. XearLC and XearRC are the ground pins if the output works in a single-ended operation. The XearLC signal is multiplexed with a video output signal coming from the application processor ASIC side.

In the system connector side, HSEAR P and HSEAR N form the left channel output, and HSEAR R P and HSEAR R N the right channel output. Respectively, HSEAR N and HSEAR R N are the ground pins if the output works in a single-ended operation.

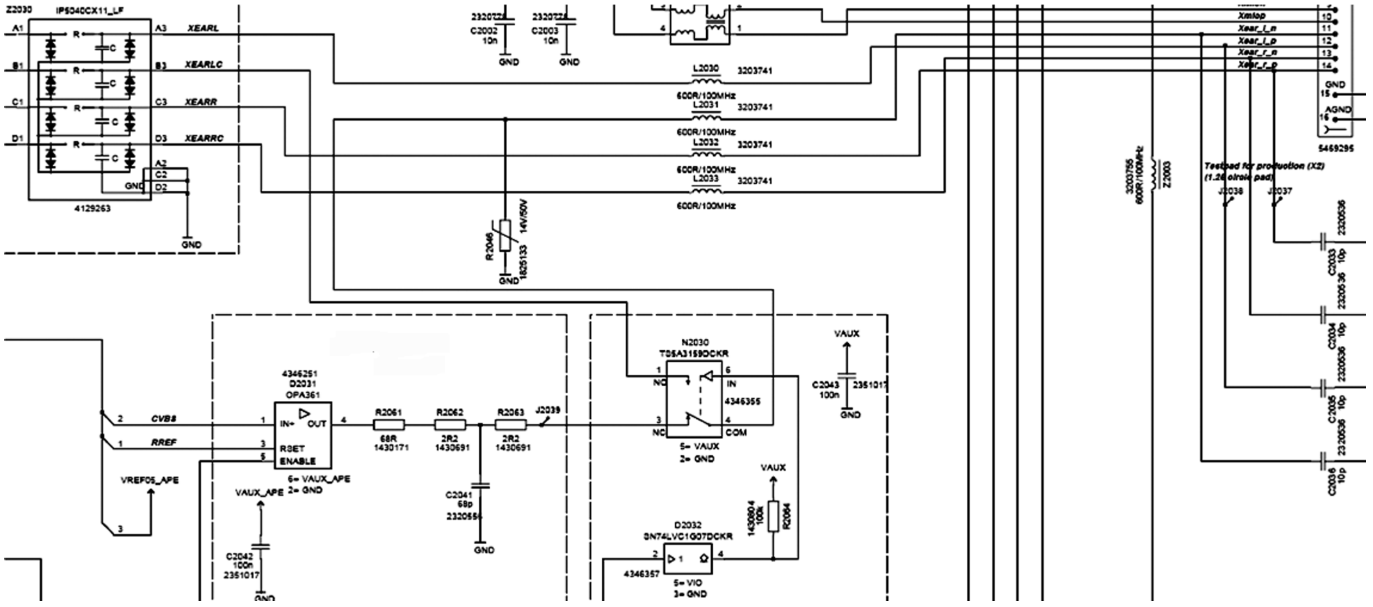

Z2030
IP5040CX11_LF
A1
B1
C1
D1
A3
XEARL
B3
XEARLC
C3
XEARR
D3
XEARRC
A2
C2
D2
GND
4129263
GND
C2002
10n
C2003
10n
GND
GND
L2030
3203741
600R/100MHz
L2031
3203741
600R/100MHz
L2032
3203741
600R/100MHz
L2033
3203741
600R/100MHz
R2046
14V/50V
1825133
GND
Xmiop
Xear_l_n
Xear_l_p
Xear_r_n
Xear_r_p
10
11
12
13
14
GND
15
AGND
16
5469295
Z2003
600R/100MHz
Testpad for production (X2)
(1.26 circle pad)
J2038
J2037
C2033
10p
2320536
C2034
10p
2320536
C2035
10p
2320536
C2036
10p
2320536
CVBS
RREF
VREF05_APE
4346251
D2031
OPA361
IN+
OUT
RSET
ENABLE
6= VAUX_APE
2= GND
VAUX_APE
R2061
68R
1430171
R2062
2R2
1430691
R2063
2R2
1430691
J2039
C2041
68p
2320556
GND
C2042
100n
2351017
GND
N2030
TS5A3159DCKR
NC
IN
4346355
NO
COM
5= VAUX
2= GND
VAUX
C2043
100n
2351017
GND
VAUX
1430604
100k
R2064
D2032
SN74LVC1G07DCKR
4346357
5= VIO
3= GND

Figure 50 External earpiece circuitry (system connector connected on the right)

SMD microphone handling

The membranes of SMD microphones are fragile and break easily. It is strictly forbidden to expose the membrane to a vacuum or to a "compressed air pistol" during cleaning of the board at any phase without protecting the microphone from the high pressure air.

> **Note:** It is strictly forbidden to touch the membrane. It is recommended that the microphone is not touched manually at all.

Vibra circuitry

Vibra is used for the vibra alarm function.

The vibra motor is connected to the EM ASIC (N2200) VibraP and VibraN Pulse Width Modulated (PWM) outputs.

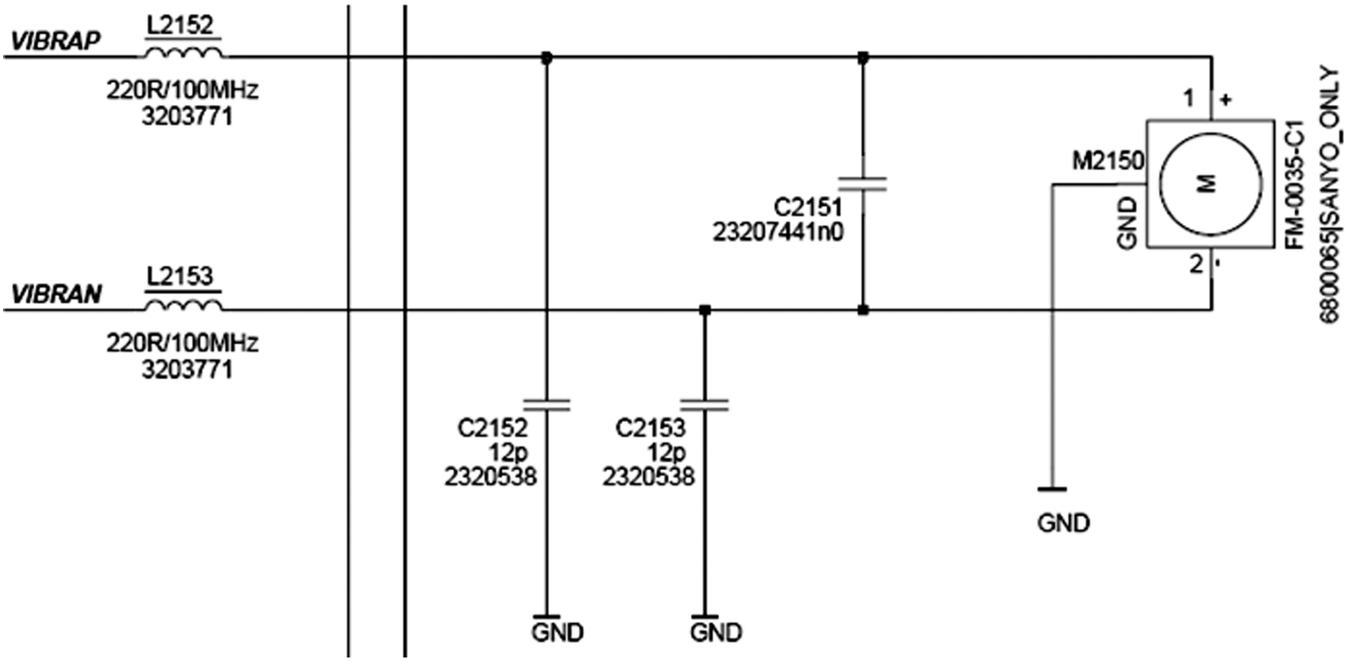

VIBRAP
L2152
220R/100MHz
3203771
VIBRAN
L2153
220R/100MHz
3203771
C2151
23207441n0
C2152
12p
2320538
C2153
12p
2320538
GND
GND
GND
M2150
GND
M
1
+
2
FM-0035-C1
6800065|SANYO_ONLY

Figure 51 Vibra circuitry

The vibra is connected to the engine PWB through springs attached to the vibra motor body – X2100 and X2101 are hard gold plated contact pads on the PWB.

System connector

The system connector provides a fully differential 4–wire stereo line-level output connection and a fully differential 2-wire mono line-level or microphone level input connection.

The handsfree driver in N2200 is meant for the headset.

The output is driven in a fully differential mode. In the fully differential mode, the handsfree pin is the negative output and the HFCM pin is the positive output. The gain of the handsfree driver in the differential mode is 6 dB.

The HEAR N is multiplexed with a video output signal. When the video out cable is connected, the system detects it via ACI, and switches from Xear N signal to video output automatically.

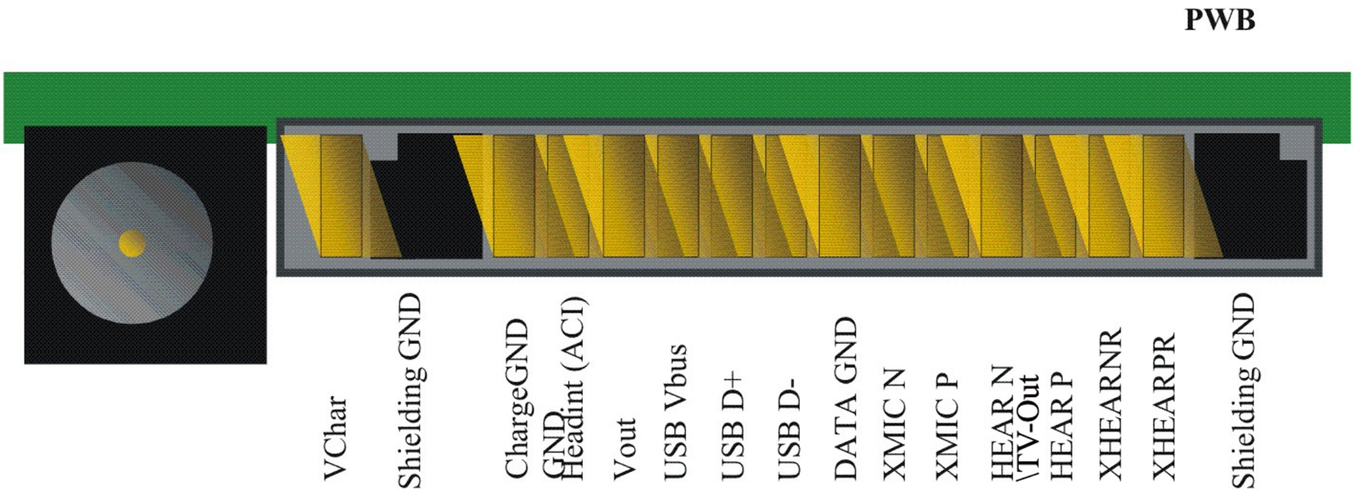

PWB
VChar
Shielding GND
ChargeGND
GND
Headint (ACI)
Vout
USB Vbus
USB D+
USB D-
DATA GND
XMIC N
XMIC P
HEAR N
\TV-Out
HEAR P
XHEARNR
XHEARPR
Shielding GND

Figure 52 External audio connector

Table 10 Audio connector pin assignments

Pin #/ Signal name	Signal description	Spectral range	Voltage/ Current levels	Max or nominal serial impedance	Notes
1/ Charge	V Charge	DC	0-9V/ 0.85A		
2/ GND	Charge GND	-	0.85A	100mΩ (PWB+ conn.)	
3/ ACI	ACI	1kbits/s	Digital 0 / 2.5-2.78V	47Ω	Insertion & removal detection
4/ Vout	DC out	DC	2.78V 70 mA 2.5V 90mA	100mΩ (PWB+ conn.)	200mW
9 / XMIC N	Audio in	300-8k	1Vpp & 2.5-2.78VDC		
10 / XMIC P	Audio in	300-8k	1Vpp & 2.5-2.78VDC		
11 / HEAR N or video	Audio out or video out	20-20k or 0-6M	1Vpp	10Ω or 75Ω	Audio, video multiplex
12 / HEAR P	Audio out	20-20k	1Vpp	10Ω	
13 / HEAR R N	Audio out	20-20k	1Vpp	10Ω	Not conn. in mono
14 / HEAR R P	Audio out	20-20k	1Vpp	10Ω	Not conn. in mono

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Baseband technical specifications

External interfaces

External interfaces

Name of Connection	Connector reference
USB	X2001 (on engine PWB)
Charger	X2000 (on engine PWB)
Headset	X2001
SIM	X2 (on SDSIM flexi)
Mini SD	X1 (on SDSIM flexi)
Battery connector	X2070 (on engine PWB)
TV-out	X2001 (on engine PWB)

VOUT electrical characteristics

Description	Parameter	Min	Max	Typical	Unit	Notes
Vout regulator for external accessories	VOUT	2.43	2.57	2.5	V	Max load 90mA

SIM IF connections

Pin	Signal	I/O	Engine connection		Notes
C1	VSIM	Out	EM ASIC N2200	VSIM1	Supply voltage to SIM card, 1.8V or 3.0V.
C2	SIMRST	Out	EM ASIC N2200	SIM1Rst	Reset signal to SIM card
C3	SIMCLK	Out	EM ASIC N2200	SIM1ClkC	Clock signal to SIM card
C5	GND	-	GND		Ground
C7	SIMDATA	In/Out	EM ASIC N2200	SIM1DaC	Data input / output
SW	SIM_DET	In	EM ASIC N2200	SIMDetX	Removal detection

Charger connector and charging interface connections & electrical characteristics

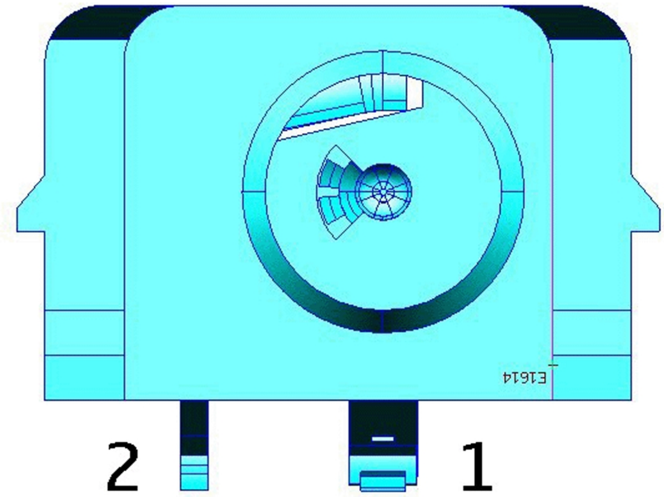


Figure 53 Charger connector

Table 11 Charging interface connections

Pin	Signal	I/O	Engine connection		Notes
1	Vchar	In	N2300	VCharIn1, 2	Charging voltage / charger detection, Center pin
2	Charge GND		Ground		Charger ground

Table 12 Charging IF electrical characteristics

Description	Parameter	Min	Max	Unit	Notes
Vchar	V Charge	0	9	V	Center pin
Vchar	I Charge		0.85	A	Center pin
Charge GND			0.85	A	

Internal interfaces

Internal interfaces

Name of Connection	Connector reference
UI connector	X4400
Display	X4401
Main camera	X8901
Sub camera	X8901
ALS	V4400

Name of Connection	Connector reference
Vibra	M2100
Microphone	B2100
Earpiece	B2101
IHF speaker	B2102

UI connections

Table 13 User interface connections

Pin	Signal	I/O	Engine connection		Notes
1	GND		GND		
2	LED+	<-	N2301	VLEDOUT2	Discrete Backlight SMPS (controlled by EM ASIC N2300)
3	Col2	->	D4800	Kbc_2	
4	LED-	->	R2305 + V2300	SETCURR2	Serial resistor + Transistor switch (controlled by EM ASIC N2300)
5	Col1	->	D4800	Kbc_1	Voice switch connection
6	GND		GND		
7	Row3	->	D4800	Kbr_3	
8	Row2	->	D4800	Kbr_2	
9	Row1	->	D4800	Kbr_1	
10	Row6	->	D4800	Kbr_6	
11	Row0	->	D4800	Kbr_0	
12	Col0	->	D4800	Kbc_0	
13	Row5	->	D4800	Kbr_5	Voice switch connection
14	Row4	->	D4800	Kbr_4	
15	GND		GND		
16	Col3	->	D4800	Kbc_3	

Back-up battery interface electrical characteristics

Table 14 Back-up battery connections

Pin name	I/O	Connection	Notes
L2207, VBack	->	N2200, VBack	Back-up battery G2200 is connected to N2200 via coil

Table 15 Back-up battery electrical characteristics

Description	Parameter	Min	Typ	Max	Unit
Back-Up Battery Voltage	Vback	0	2.5	2.7	V

RF description

Block diagram

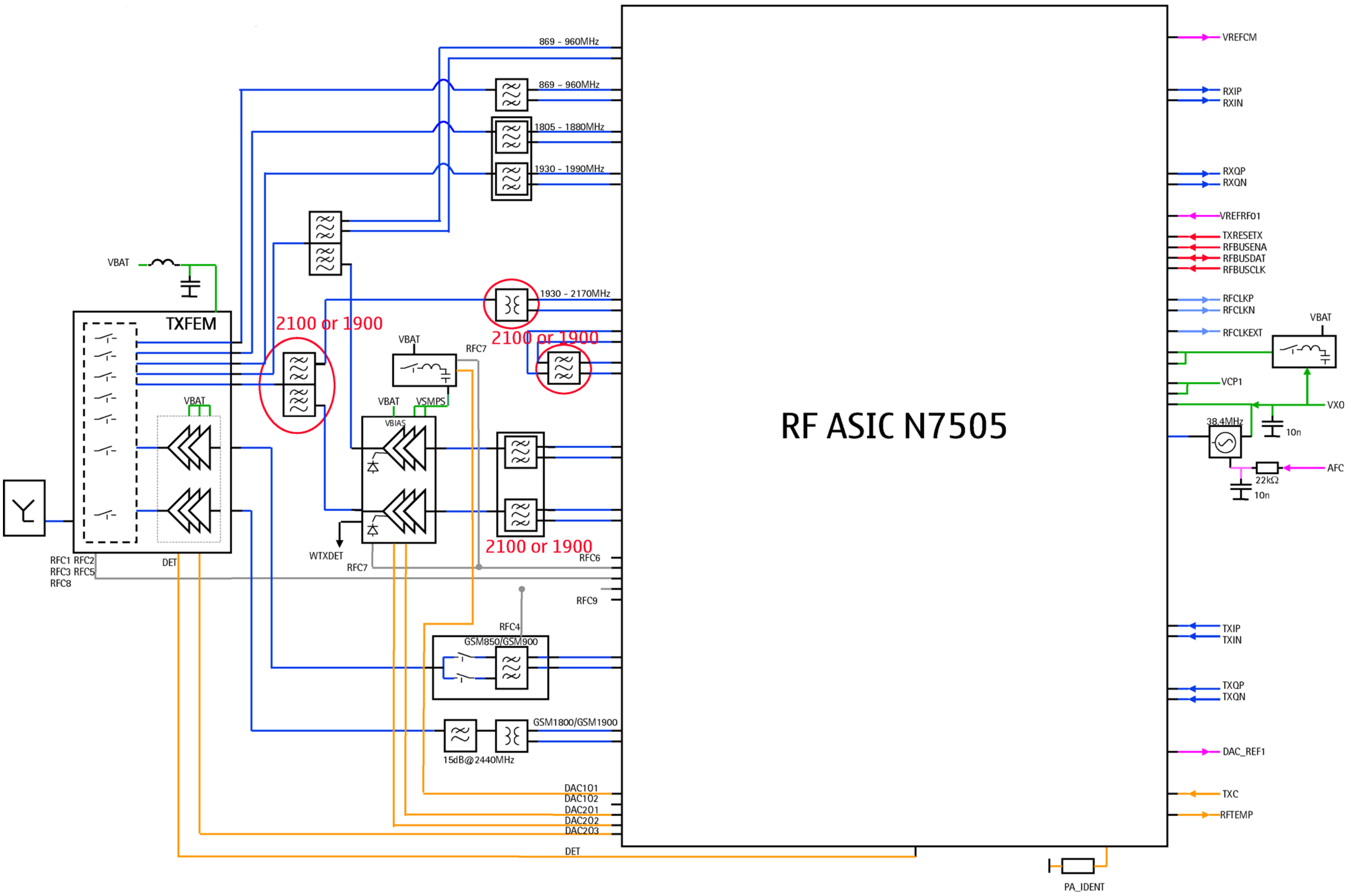

869 - 960MHz
869 - 960MHz
1805 - 1880MHz
1930 - 1990MHz
VBAT
TXFEM
VBAT
2100 or 1900
1930 - 2170MHz
2100 or 1900
VBAT
RFC7
VBAT
VSMPS
VBIAS
WTXDET
RFC7
2100 or 1900
RFC6
RFC1 RFC2
RFC3 RFC5
RFC8
DET
RFC9
RFC4
GSM850/GSM900
GSM1800/GSM1900
15dB@2440MHz
DAC101
DAC102
DAC201
DAC202
DAC203
DET
RF ASIC N7505
VREFCM
RXIP
RXIN
RXQP
RXQN
VREFRFO1
TXRESETX
RFBUSENA
RFBUSDAT
RFBUSCLK
RFCLKP
RFCLKN
RFCLKEXT
VBAT
VCP1
VXO
38.4MHz
10n
AFC
22kΩ
10n
TXIP
TXIN
TXQP
TXQN
DAC_REF1
TXC
RFTEMP
PA_IDENT

Figure 54 RF block diagram RM-159 using RF ASIC N7505

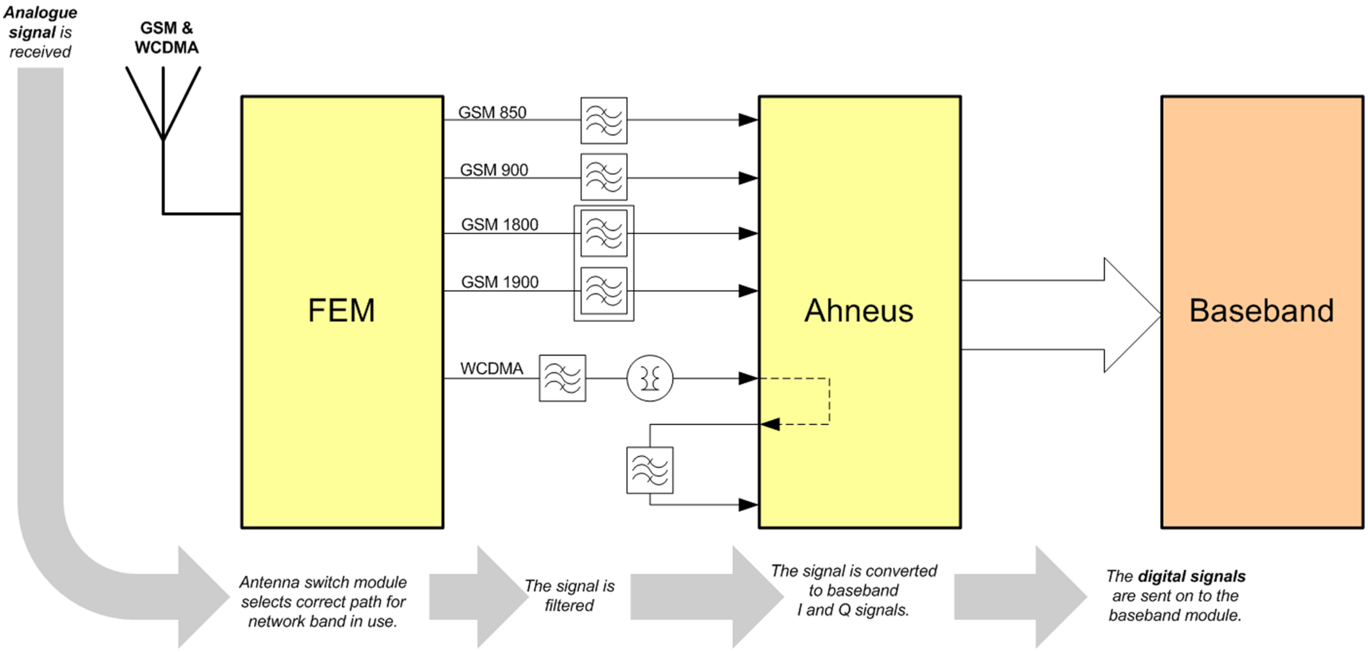
The RF block diagram for RM-159 uses RF ASIC N7505 that performs the RF back-end functions of receive and transmit function of the cellular transceiver.

Receiver (RX)

An analogue signal is received by the phone's antenna. The signal is converted to a digital signal and is then transferred further to the baseband (eg. to the earpiece).

The receiver functions are implemented in the RF ASIC.

Signals with different frequencies take different paths, therefore being handled by different components. The principle of GSM and WCDMA is the same.

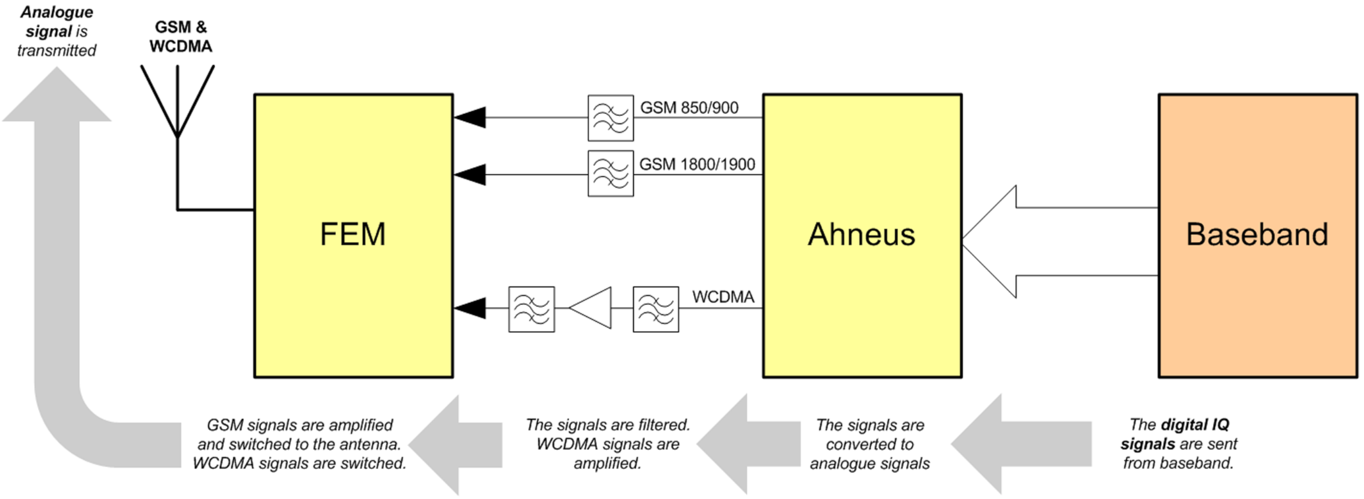

Analogue signal is received
GSM & WCDMA
FEM
GSM 850
GSM 900
GSM 1800
GSM 1900
WCDMA
Ahneus
Baseband
Antenna switch module selects correct path for network band in use.
The signal is filtered
The signal is converted to baseband I and Q signals.
The **digital signals** are sent on to the baseband module.

Transmitter (TX)

The digital baseband signal (eg. from the microphone) is converted to an analogue signal, which is then amplified and transmitted from the antenna. The frequency of this signal can be tuned to match the bandwith of the system in use (eg. GSM900).

The transmitter functions are implemented in the RF ASIC.

Even though the GSM and WCDMA signals are sent via different components, the principles of the transmission is the same.


Analogue signal is transmitted
GSM & WCDMA
FEM
GSM 850/900
GSM 1800/1900
WCDMA
Ahneus
Baseband
GSM signals are amplified and switched to the antenna. WCDMA signals are switched.
The signals are filtered. WCDMA signals are amplified.
The signals are converted to analogue signals
The **digital IQ signals** are sent from baseband.

Frequency mappings

GSM850 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
128	824.2	869.2	3296.8	3476.8	170	832.6	877.6	3330.4	3510.4	212	841.0	886.0	3364.0	3544.0
129	824.4	869.4	3297.6	3477.6	171	832.8	877.8	3331.2	3511.2	213	841.2	886.2	3364.8	3544.8
130	824.6	869.6	3298.4	3478.4	172	833.0	878.0	3332.0	3512.0	214	841.4	886.4	3365.6	3545.6
131	824.8	869.8	3299.2	3479.2	173	833.2	878.2	3332.8	3512.8	215	841.6	886.6	3366.4	3546.4
132	825.0	870.0	3300.0	3480.0	174	833.4	878.4	3333.6	3513.6	216	841.8	886.8	3367.2	3547.2
133	825.2	870.2	3300.8	3480.8	175	833.6	878.6	3334.4	3514.4	217	842.0	887.0	3368.0	3548.0
134	825.4	870.4	3301.6	3481.6	176	833.8	878.8	3335.2	3515.2	218	842.2	887.2	3368.8	3548.8
135	825.6	870.6	3302.4	3482.4	177	834.0	879.0	3336.0	3516.0	219	842.4	887.4	3369.6	3549.6
136	825.8	870.8	3303.2	3483.2	178	834.2	879.2	3336.8	3516.8	220	842.6	887.6	3370.4	3550.4
137	826.0	871.0	3304.0	3484.0	179	834.4	879.4	3337.6	3517.6	221	842.8	887.8	3371.2	3551.2
138	826.2	871.2	3304.8	3484.8	180	834.6	879.6	3338.4	3518.4	222	843.0	888.0	3372.0	3552.0
139	826.4	871.4	3305.6	3485.6	181	834.8	879.8	3339.2	3519.2	223	843.2	888.2	3372.8	3552.8
140	826.6	871.6	3306.4	3486.4	182	835.0	880.0	3340.0	3520.0	224	843.4	888.4	3373.6	3553.6
141	826.8	871.8	3307.2	3487.2	183	835.2	880.2	3340.8	3520.8	225	843.6	888.6	3374.4	3554.4
142	827.0	872.0	3308.0	3488.0	184	835.4	880.4	3341.6	3521.6	226	843.8	888.8	3375.2	3555.2
143	827.2	872.2	3308.8	3488.8	185	835.6	880.6	3342.4	3522.4	227	844.0	889.0	3376.0	3556.0
144	827.4	872.4	3309.6	3489.6	186	835.8	880.8	3343.2	3523.2	228	844.2	889.2	3376.8	3556.8
145	827.6	872.6	3310.4	3490.4	187	836.0	881.0	3344.0	3524.0	229	844.4	889.4	3377.6	3557.6
146	827.8	872.8	3311.2	3491.2	188	836.2	881.2	3344.8	3524.8	230	844.6	889.6	3378.4	3558.4
147	828.0	873.0	3312.0	3492.0	189	836.4	881.4	3345.6	3525.6	231	844.8	889.8	3379.2	3559.2
148	828.2	873.2	3312.8	3492.8	190	836.6	881.6	3346.4	3526.4	232	845.0	890.0	3380.0	3560.0
149	828.4	873.4	3313.6	3493.6	191	836.8	881.8	3347.2	3527.2	233	845.2	890.2	3380.8	3560.8
150	828.6	873.6	3314.4	3494.4	192	837.0	882.0	3348.0	3528.0	234	845.4	890.4	3381.6	3561.6
151	828.8	873.8	3315.2	3495.2	193	837.2	882.2	3348.8	3528.8	235	845.6	890.6	3382.4	3562.4
152	829.0	874.0	3316.0	3496.0	194	837.4	882.4	3349.6	3529.6	236	845.8	890.8	3383.2	3563.2
153	829.2	874.2	3316.8	3496.8	195	837.6	882.6	3350.4	3530.4	237	846.0	891.0	3384.0	3564.0
154	829.4	874.4	3317.6	3497.6	196	837.8	882.8	3351.2	3531.2	238	846.2	891.2	3384.8	3564.8
155	829.6	874.6	3318.4	3498.4	197	838.0	883.0	3352.0	3532.0	239	846.4	891.4	3385.6	3565.6
156	829.8	874.8	3319.2	3499.2	198	838.2	883.2	3352.8	3532.8	240	846.6	891.6	3386.4	3566.4
157	830.0	875.0	3320.0	3500.0	199	838.4	883.4	3353.6	3533.6	241	846.8	891.8	3387.2	3567.2
158	830.2	875.2	3320.8	3500.8	200	838.6	883.6	3354.4	3534.4	242	847.0	892.0	3388.0	3568.0
159	830.4	875.4	3321.6	3501.6	201	838.8	883.8	3355.2	3535.2	243	847.2	892.2	3388.8	3568.8
160	830.6	875.6	3322.4	3502.4	202	839.0	884.0	3356.0	3536.0	244	847.4	892.4	3389.6	3569.6
161	830.8	875.8	3323.2	3503.2	203	839.2	884.2	3356.8	3536.8	245	847.6	892.6	3390.4	3570.4
162	831.0	876.0	3324.0	3504.0	204	839.4	884.4	3357.6	3537.6	246	847.8	892.8	3391.2	3571.2
163	831.2	876.2	3324.8	3504.8	205	839.6	884.6	3358.4	3538.4	247	848.0	893.0	3392.0	3572.0
164	831.4	876.4	3325.6	3505.6	206	839.8	884.8	3359.2	3539.2	248	848.2	893.2	3392.8	3572.8
165	831.6	876.6	3326.4	3506.4	207	840.0	885.0	3360.0	3540.0	249	848.4	893.4	3393.6	3573.6
166	831.8	876.8	3327.2	3507.2	208	840.2	885.2	3360.8	3540.8	250	848.6	893.6	3394.4	3574.4
167	832.0	877.0	3328.0	3508.0	209	840.4	885.4	3361.6	3541.6	251	848.8	893.8	3395.2	3575.2

EGSM900 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
975	880,2	925,2	3520,8	3700,8	1	890,2	935,2	3560,8	3740,8	63	902,6	947,6	3610,4	3790,4
976	880,4	925,4	3521,6	3701,6	2	890,4	935,4	3561,6	3741,6	64	902,8	947,8	3611,2	3791,2
977	880,6	925,6	3522,4	3702,4	3	890,6	935,6	3562,4	3742,4	65	903,0	948,0	3612,0	3792,0
978	880,8	925,8	3523,2	3703,2	4	890,8	935,8	3563,2	3743,2	66	903,2	948,2	3612,8	3792,8
979	881,0	926,0	3524,0	3704,0	5	891,0	936,0	3564,0	3744,0	67	903,4	948,4	3613,6	3793,6
980	881,2	926,2	3524,8	3704,8	6	891,2	936,2	3564,8	3744,8	68	903,6	948,6	3614,4	3794,4
981	881,4	926,4	3525,6	3705,6	7	891,4	936,4	3565,6	3745,6	69	903,8	948,8	3615,2	3795,2
982	881,6	926,6	3526,4	3706,4	8	891,6	936,6	3566,4	3746,4	70	904,0	949,0	3616,0	3796,0
983	881,8	926,8	3527,2	3707,2	9	891,8	936,8	3567,2	3747,2	71	904,2	949,2	3616,8	3796,8
984	882,0	927,0	3528,0	3708,0	10	892,0	937,0	3568,0	3748,0	72	904,4	949,4	3617,6	3797,6
985	882,2	927,2	3528,8	3708,8	11	892,2	937,2	3568,8	3748,8	73	904,6	949,6	3618,4	3798,4
986	882,4	927,4	3529,6	3709,6	12	892,4	937,4	3569,6	3749,6	74	904,8	949,8	3619,2	3799,2
987	882,6	927,6	3530,4	3710,4	13	892,6	937,6	3570,4	3750,4	75	905,0	950,0	3620,0	3800,0
988	882,8	927,8	3531,2	3711,2	14	892,8	937,8	3571,2	3751,2	76	905,2	950,2	3620,8	3800,8
989	883,0	928,0	3532,0	3712,0	15	893,0	938,0	3572,0	3752,0	77	905,4	950,4	3621,6	3801,6
990	883,2	928,2	3532,8	3712,8	16	893,2	938,2	3572,8	3752,8	78	905,6	950,6	3622,4	3802,4
991	883,4	928,4	3533,6	3713,6	17	893,4	938,4	3573,6	3753,6	79	905,8	950,8	3623,2	3803,2
992	883,6	928,6	3534,4	3714,4	18	893,6	938,6	3574,4	3754,4	80	906,0	951,0	3624,0	3804,0
993	883,8	928,8	3535,2	3715,2	19	893,8	938,8	3575,2	3755,2	81	906,2	951,2	3624,8	3804,8
994	884,0	929,0	3536,0	3716,0	20	894,0	939,0	3576,0	3756,0	82	906,4	951,4	3625,6	3805,6
995	884,2	929,2	3536,8	3716,8	21	894,2	939,2	3576,8	3756,8	83	906,6	951,6	3626,4	3806,4
996	884,4	929,4	3537,6	3717,6	22	894,4	939,4	3577,6	3757,6	84	906,8	951,8	3627,2	3807,2
997	884,6	929,6	3538,4	3718,4	23	894,6	939,6	3578,4	3758,4	85	907,0	952,0	3628,0	3808,0
998	884,8	929,8	3539,2	3719,2	24	894,8	939,8	3579,2	3759,2	86	907,2	952,2	3628,8	3808,8
999	885,0	930,0	3540,0	3720,0	25	895,0	940,0	3580,0	3760,0	87	907,4	952,4	3629,6	3809,6
1000	885,2	930,2	3540,8	3720,8	26	895,2	940,2	3580,8	3760,8	88	907,6	952,6	3630,4	3810,4
1001	885,4	930,4	3541,6	3721,6	27	895,4	940,4	3581,6	3761,6	89	907,8	952,8	3631,2	3811,2
1002	885,6	930,6	3542,4	3722,4	28	895,6	940,6	3582,4	3762,4	90	908,0	953,0	3632,0	3812,0
1003	885,8	930,8	3543,2	3723,2	29	895,8	940,8	3583,2	3763,2	91	908,2	953,2	3632,8	3812,8
1004	886,0	931,0	3544,0	3724,0	30	896,0	941,0	3584,0	3764,0	92	908,4	953,4	3633,6	3813,6
1005	886,2	931,2	3544,8	3724,8	31	896,2	941,2	3584,8	3764,8	93	908,6	953,6	3634,4	3814,4
1006	886,4	931,4	3545,6	3725,6	32	896,4	941,4	3585,6	3765,6	94	908,8	953,8	3635,2	3815,2
1007	886,6	931,6	3546,4	3726,4	33	896,6	941,6	3586,4	3766,4	95	909,0	954,0	3636,0	3816,0
1008	886,8	931,8	3547,2	3727,2	34	896,8	941,8	3587,2	3767,2	96	909,2	954,2	3636,8	3816,8
1009	887,0	932,0	3548,0	3728,0	35	897,0	942,0	3588,0	3768,0	97	909,4	954,4	3637,6	3817,6
1010	887,2	932,2	3548,8	3728,8	36	897,2	942,2	3588,8	3768,8	98	909,6	954,6	3638,4	3818,4
1011	887,4	932,4	3549,6	3729,6	37	897,4	942,4	3589,6	3769,6	99	909,8	954,8	3639,2	3819,2
1012	887,6	932,6	3550,4	3730,4	38	897,6	942,6	3590,4	3770,4	100	910,0	955,0	3640,0	3820,0
1013	887,8	932,8	3551,2	3731,2	39	897,8	942,8	3591,2	3771,2	101	910,2	955,2	3640,8	3820,8
1014	888,0	933,0	3552,0	3732,0	40	898,0	943,0	3592,0	3772,0	102	910,4	955,4	3641,6	3821,6
1015	888,2	933,2	3552,8	3732,8	41	898,2	943,2	3592,8	3772,8	103	910,6	955,6	3642,4	3822,4
1016	888,4	933,4	3553,6	3733,6	42	898,4	943,4	3593,6	3773,6	104	910,8	955,8	3643,2	3823,2
1017	888,6	933,6	3554,4	3734,4	43	898,6	943,6	3594,4	3774,4	105	911,0	956,0	3644,0	3824,0
1018	888,8	933,8	3555,2	3735,2	44	898,8	943,8	3595,2	3775,2	106	911,2	956,2	3644,8	3824,8
1019	889,0	934,0	3556,0	3736,0	45	899,0	944,0	3596,0	3776,0	107	911,4	956,4	3645,6	3825,6
1020	889,2	934,2	3556,8	3736,8	46	899,2	944,2	3596,8	3776,8	108	911,6	956,6	3646,4	3826,4
1021	889,4	934,4	3557,6	3737,6	47	899,4	944,4	3597,6	3777,6	109	911,8	956,8	3647,2	3827,2
1022	889,6	934,6	3558,4	3738,4	48	899,6	944,6	3598,4	3778,4	110	912,0	957,0	3648,0	3828,0
1023	889,8	934,8	3559,2	3739,2	49	899,8	944,8	3599,2	3779,2	111	912,2	957,2	3648,8	3828,8
0	890,0	935,0	3560,0	3740,0	50	900,0	945,0	3600,0	3780,0	112	912,4	957,4	3649,6	3829,6
					51	900,2	945,2	3600,8	3780,8	113	912,6	957,6	3650,4	3830,4
					52	900,4	945,4	3601,6	3781,6	114	912,8	957,8	3651,2	3831,2
					53	900,6	945,6	3602,4	3782,4	115	913,0	958,0	3652,0	3832,0
					54	900,8	945,8	3603,2	3783,2	116	913,2	958,2	3652,8	3832,8
					55	901,0	946,0	3604,0	3784,0	117	913,4	958,4	3653,6	3833,6
					56	901,2	946,2	3604,8	3784,8	118	913,6	958,6	3654,4	3834,4
					57	901,4	946,4	3605,6	3785,6	119	913,8	958,8	3655,2	3835,2
					58	901,6	946,6	3606,4	3786,4	120	914,0	959,0	3656,0	3836,0
					59	901,8	946,8	3607,2	3787,2	121	914,2	959,2	3656,8	3836,8
					60	902,0	947,0	3608,0	3788,0	122	914,4	959,4	3657,6	3837,6
					61	902,2	947,2	3608,8	3788,8	123	914,6	959,6	3658,4	3838,4
					62	902,4	947,4	3609,6	3789,6	124	914,8	959,8	3659,2	3839,2

GSM1800 frequencies

Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx
512	1710.2	1805.2	3420.4	3610.4	606	1729.0	1824.0	3458.0	3648.0	700	1747.8	1842.8	3495.6	3685.6	793	1766.4	1861.4	3532.8	3722.8
513	1710.4	1805.4	3420.8	3610.8	607	1729.2	1824.2	3458.4	3648.4	701	1748.0	1843.0	3496.0	3686.0	794	1766.6	1861.6	3533.2	3723.2
514	1710.6	1805.6	3421.2	3611.2	608	1729.4	1824.4	3458.8	3648.8	702	1748.2	1843.2	3496.4	3686.4	795	1766.8	1861.8	3533.6	3723.6
515	1710.8	1805.8	3421.6	3611.6	609	1729.6	1824.6	3459.2	3649.2	703	1748.4	1843.4	3496.8	3686.8	796	1767.0	1862.0	3534.0	3724.0
516	1711.0	1806.0	3422.0	3612.0	610	1729.8	1824.8	3459.6	3649.6	704	1748.6	1843.6	3497.2	3687.2	797	1767.2	1862.2	3534.4	3724.4
517	1711.2	1806.2	3422.4	3612.4	611	1730.0	1825.0	3460.0	3650.0	705	1748.8	1843.8	3497.6	3687.6	798	1767.4	1862.4	3534.8	3724.8
518	1711.4	1806.4	3422.8	3612.8	612	1730.2	1825.2	3460.4	3650.4	706	1749.0	1844.0	3498.0	3688.0	799	1767.6	1862.6	3535.2	3725.2
519	1711.6	1806.6	3423.2	3613.2	613	1730.4	1825.4	3460.8	3650.8	707	1749.2	1844.2	3498.4	3688.4	800	1767.8	1862.8	3535.6	3725.6
520	1711.8	1806.8	3423.6	3613.6	614	1730.6	1825.6	3461.2	3651.2	708	1749.4	1844.4	3498.8	3688.8	801	1768.0	1863.0	3536.0	3726.0
521	1712.0	1807.0	3424.0	3614.0	615	1730.8	1825.8	3461.6	3651.6	709	1749.6	1844.6	3499.2	3689.2	802	1768.2	1863.2	3536.4	3726.4
522	1712.2	1807.2	3424.4	3614.4	616	1731.0	1826.0	3462.0	3652.0	710	1749.8	1844.8	3499.6	3689.6	803	1768.4	1863.4	3536.8	3726.8
523	1712.4	1807.4	3424.8	3614.8	617	1731.2	1826.2	3462.4	3652.4	711	1750.0	1845.0	3500.0	3690.0	804	1768.6	1863.6	3537.2	3727.2
524	1712.6	1807.6	3425.2	3615.2	618	1731.4	1826.4	3462.8	3652.8	712	1750.2	1845.2	3500.4	3690.4	805	1768.8	1863.8	3537.6	3727.6
525	1712.8	1807.8	3425.6	3615.6	619	1731.6	1826.6	3463.2	3653.2	713	1750.4	1845.4	3500.8	3690.8	806	1769.0	1864.0	3538.0	3728.0
526	1713.0	1808.0	3426.0	3616.0	620	1731.8	1826.8	3463.6	3653.6	714	1750.6	1845.6	3501.2	3691.2	807	1769.2	1864.2	3538.4	3728.4
527	1713.2	1808.2	3426.4	3616.4	621	1732.0	1827.0	3464.0	3654.0	715	1750.8	1845.8	3501.6	3691.6	808	1769.4	1864.4	3538.8	3728.8
528	1713.4	1808.4	3426.8	3616.8	622	1732.2	1827.2	3464.4	3654.4	716	1751.0	1846.0	3502.0	3692.0	809	1769.6	1864.6	3539.2	3729.2
529	1713.6	1808.6	3427.2	3617.2	623	1732.4	1827.4	3464.8	3654.8	717	1751.2	1846.2	3502.4	3692.4	810	1769.8	1864.8	3539.6	3729.6
530	1713.8	1808.8	3427.6	3617.6	624	1732.6	1827.6	3465.2	3655.2	718	1751.4	1846.4	3502.8	3692.8	811	1770.0	1865.0	3540.0	3730.0
531	1714.0	1809.0	3428.0	3618.0	625	1732.8	1827.8	3465.6	3655.6	719	1751.6	1846.6	3503.2	3693.2	812	1770.2	1865.2	3540.4	3730.4
532	1714.2	1809.2	3428.4	3618.4	626	1733.0	1828.0	3466.0	3656.0	720	1751.8	1846.8	3503.6	3693.6	813	1770.4	1865.4	3540.8	3730.8
533	1714.4	1809.4	3428.8	3618.8	627	1733.2	1828.2	3466.4	3656.4	721	1752.0	1847.0	3504.0	3694.0	814	1770.6	1865.6	3541.2	3731.2
534	1714.6	1809.6	3429.2	3619.2	628	1733.4	1828.4	3466.8	3656.8	722	1752.2	1847.2	3504.4	3694.4	815	1770.8	1865.8	3541.6	3731.6
535	1714.8	1809.8	3429.6	3619.6	629	1733.6	1828.6	3467.2	3657.2	723	1752.4	1847.4	3504.8	3694.8	816	1771.0	1866.0	3542.0	3732.0
536	1715.0	1810.0	3430.0	3620.0	630	1733.8	1828.8	3467.6	3657.6	724	1752.6	1847.6	3505.2	3695.2	817	1771.2	1866.2	3542.4	3732.4
537	1715.2	1810.2	3430.4	3620.4	631	1734.0	1829.0	3468.0	3658.0	725	1752.8	1847.8	3505.6	3695.6	818	1771.4	1866.4	3542.8	3732.8
538	1715.4	1810.4	3430.8	3620.8	632	1734.2	1829.2	3468.4	3658.4	726	1753.0	1848.0	3506.0	3696.0	819	1771.6	1866.6	3543.2	3733.2
539	1715.6	1810.6	3431.2	3621.2	633	1734.4	1829.4	3468.8	3658.8	727	1753.2	1848.2	3506.4	3696.4	820	1771.8	1866.8	3543.6	3733.6
540	1715.8	1810.8	3431.6	3621.6	634	1734.6	1829.6	3469.2	3659.2	728	1753.4	1848.4	3506.8	3696.8	821	1772.0	1867.0	3544.0	3734.0
541	1716.0	1811.0	3432.0	3622.0	635	1734.8	1829.8	3469.6	3659.6	729	1753.6	1848.6	3507.2	3697.2	822	1772.2	1867.2	3544.4	3734.4
542	1716.2	1811.2	3432.4	3622.4	636	1735.0	1830.0	3470.0	3660.0	730	1753.8	1848.8	3507.6	3697.6	823	1772.4	1867.4	3544.8	3734.8
543	1716.4	1811.4	3432.8	3622.8	637	1735.2	1830.2	3470.4	3660.4	731	1754.0	1849.0	3508.0	3698.0	824	1772.6	1867.6	3545.2	3735.2
544	1716.6	1811.6	3433.2	3623.2	638	1735.4	1830.4	3470.8	3660.8	732	1754.2	1849.2	3508.4	3698.4	825	1772.8	1867.8	3545.6	3735.6
545	1716.8	1811.8	3433.6	3623.6	639	1735.6	1830.6	3471.2	3661.2	733	1754.4	1849.4	3508.8	3698.8	826	1773.0	1868.0	3546.0	3736.0
546	1717.0	1812.0	3434.0	3624.0	640	1735.8	1830.8	3471.6	3661.6	734	1754.6	1849.6	3509.2	3699.2	827	1773.2	1868.2	3546.4	3736.4
547	1717.2	1812.2	3434.4	3624.4	641	1736.0	1831.0	3472.0	3662.0	735	1754.8	1849.8	3509.6	3699.6	828	1773.4	1868.4	3546.8	3736.8
548	1717.4	1812.4	3434.8	3624.8	642	1736.2	1831.2	3472.4	3662.4	736	1755.0	1850.0	3510.0	3700.0	829	1773.6	1868.6	3547.2	3737.2
549	1717.6	1812.6	3435.2	3625.2	643	1736.4	1831.4	3472.8	3662.8	737	1755.2	1850.2	3510.4	3700.4	830	1773.8	1868.8	3547.6	3737.6
550	1717.8	1812.8	3435.6	3625.6	644	1736.6	1831.6	3473.2	3663.2	738	1755.4	1850.4	3510.8	3700.8	831	1774.0	1869.0	3548.0	3738.0
551	1718.0	1813.0	3436.0	3626.0	645	1736.8	1831.8	3473.6	3663.6	739	1755.6	1850.6	3511.2	3701.2	832	1774.2	1869.2	3548.4	3738.4
552	1718.2	1813.2	3436.4	3626.4	646	1737.0	1832.0	3474.0	3664.0	740	1755.8	1850.8	3511.6	3701.6	833	1774.4	1869.4	3548.8	3738.8
553	1718.4	1813.4	3436.8	3626.8	647	1737.2	1832.2	3474.4	3664.4	741	1756.0	1851.0	3512.0	3702.0	834	1774.6	1869.6	3549.2	3739.2
554	1718.6	1813.6	3437.2	3627.2	648	1737.4	1832.4	3474.8	3664.8	742	1756.2	1851.2	3512.4	3702.4	835	1774.8	1869.8	3549.6	3739.6
555	1718.8	1813.8	3437.6	3627.6	649	1737.6	1832.6	3475.2	3665.2	743	1756.4	1851.4	3512.8	3702.8	836	1775.0	1870.0	3550.0	3740.0
556	1719.0	1814.0	3438.0	3628.0	650	1737.8	1832.8	3475.6	3665.6	744	1756.6	1851.6	3513.2	3703.2	837	1775.2	1870.2	3550.4	3740.4
557	1719.2	1814.2	3438.4	3628.4	651	1738.0	1833.0	3476.0	3666.0	745	1756.8	1851.8	3513.6	3703.6	838	1775.4	1870.4	3550.8	3740.8
558	1719.4	1814.4	3438.8	3628.8	652	1738.2	1833.2	3476.4	3666.4	746	1757.0	1852.0	3514.0	3704.0	839	1775.6	1870.6	3551.2	3741.2
559	1719.6	1814.6	3439.2	3629.2	653	1738.4	1833.4	3476.8	3666.8	747	1757.2	1852.2	3514.4	3704.4	840	1775.8	1870.8	3551.6	3741.6
560	1719.8	1814.8	3439.6	3629.6	654	1738.6	1833.6	3477.2	3667.2	748	1757.4	1852.4	3514.8	3704.8	841	1776.0	1871.0	3552.0	3742.0
561	1720.0	1815.0	3440.0	3630.0	655	1738.8	1833.8	3477.6	3667.6	749	1757.6	1852.6	3515.2	3705.2	842	1776.2	1871.2	3552.4	3742.4
562	1720.2	1815.2	3440.4	3630.4	656	1739.0	1834.0	3478.0	3668.0	750	1757.8	1852.8	3515.6	3705.6	843	1776.4	1871.4	3552.8	3742.8
563	1720.4	1815.4	3440.8	3630.8	657	1739.2	1834.2	3478.4	3668.4	751	1758.0	1853.0	3516.0	3706.0	844	1776.6	1871.6	3553.2	3743.2
564	1720.6	1815.6	3441.2	3631.2	658	1739.4	1834.4	3478.8	3668.8	752	1758.2	1853.2	3516.4	3706.4	845	1776.8	1871.8	3553.6	3743.6
565	1720.8	1815.8	3441.6	3631.6	659	1739.6	1834.6	3479.2	3669.2	753	1758.4	1853.4	3516.8	3706.8	846	1777.0	1872.0	3554.0	3744.0
566	1721.0	1816.0	3442.0	3632.0	660	1739.8	1834.8	3479.6	3669.6	754	1758.6	1853.6	3517.2	3707.2	847	1777.2	1872.2	3554.4	3744.4
567	1721.2	1816.2	3442.4	3632.4	661	1740.0	1835.0	3480.0	3670.0	755	1758.8	1853.8	3517.6	3707.6	848	1777.4	1872.4	3554.8	3744.8
568	1721.4	1816.4	3442.8	3632.8	662	1740.2	1835.2	3480.4	3670.4	756	1759.0	1854.0	3518.0	3708.0	849	1777.6	1872.6	3555.2	3745.2
569	1721.6	1816.6	3443.2	3633.2	663	1740.4	1835.4	3480.8	3670.8	757	1759.2	1854.2	3518.4	3708.4	850	1777.8	1872.8	3555.6	3745.6
570	1721.8	1816.8	3443.6	3633.6	664	1740.6	1835.6	3481.2	3671.2	758	1759.4	1854.4	3518.8	3708.8	851	1778.0	1873.0	3556.0	3746.0
571	1722.0	1817.0	3444.0	3634.0	665	1740.8	1835.8	3481.6	3671.6	759	1759.6	1854.6	3519.2	3709.2	852	1778.2	1873.2	3556.4	3746.4
572	1722.2	1817.2	3444.4	3634.4	666	1741.0	1836.0	3482.0	3672.0	760	1759.8	1854.8	3519.6	3709.6	853	1778.4	1873.4	3556.8	3746.8
573	1722.4	1817.4	3444.8	3634.8	667	1741.2	1836.2	3482.4	3672.4	761	1760.0	1855.0	3520.0	3710.0	854	1778.6	1873.6	3557.2	3747.2
574	1722.6	1817.6	3445.2	3635.2	668	1741.4	1836.4	3482.8	3672.8	762	1760.2	1855.2	3520.4	3710.4	855	1778.8	1873.8	3557.6	3747.6
575	1722.8	1817.8	3445.6	3635.6	669	1741.6	1836.6	3483.2	3673.2	763	1760.4	1855.4	3520.8	3710.8	856	1779.0	1874.0	3558.0	3748.0
576	1723.0	1818.0	3446.0	3636.0	670	1741.8	1836.8	3483.6	3673.6	764	1760.6	1855.6	3521.2	3711.2	857	1779.2	1874.2	3558.4	3748.4
577	1723.2	1818.2	3446.4	3636.4	671	1742.0	1837.0	3484.0	3674.0	765	1760.8	1855.8	3521.6	3711.6	858	1779.4	1874.4	3558.8	3748.8
578	1723.4	1818.4	3446.8	3636.8	672	1742.2	1837.2	3484.4	3674.4	766	1761.0	1856.0	3522.0	3712.0	859	1779.6	1874.6	3559.2	3749.2
579	1723.6	1818.6	3447.2	3637.2	673	1742.4	1837.4	3484.8	3674.8	767	1761.2	1856.2	3522.4	3712.4	860	1779.8	1874.8	3559.6	3749.6
580	1723.8	1818.8	3447.6	3637.6	674	1742.6	1837.6	3485.2	3675.2	768	1761.4	1856.4	3522.8	3712.8	861	1780.0	1875.0	3560.0	3750.0
581	1724.0	1819.0	3448.0	3638.0	675	1742.8	1837.8	3485.6	3675.6	769	1761.6	1856.6	3523.2	3713.2	862	1780.2	1875.2	3560.4	3750.4
582	1724.2	1819.2	3448.4	3638.4	676	1743.0	1838.0	3486.0	3676.0	770	1761.8	1856.8	3523.6	3713.6	863	1780.4	1875.4	3560.8	3750.8
583	1724.4	1819.4	3448.8	3638.8	677	1743.2	1838.2	3486.4	3676.4	771	1762.0	1857.0	3524.0	3714.0	864	1780.6	1875.6	3561.2	3751.2
584	1724.6	1819.6	3449.2	3639.2	678	1743.4	1838.4	3486.8	3676.8	772	1762.2	1857.2	3524.4	3714.4	865	1780.8	1875.8	3561.6	3751.6
585	1724.8	1819.8	3449.6	3639.6	679	1743.6	1838.6	3487.2	3677.2	773	1762.4	1857.4	3524.8	3714.8	866	1781.0	1876.0	3562.0	3752.0
586	1725.0	1820.0	3450.0	3640.0	680	1743.8	1838.8	3487.6	3677.6	774	1762.6	1857.6	3525.2	3715.2	867	1781.2	1876.2	3562.4	3752.4
587	1725.2	1820.2	3450.4	3640.4	681	1744.0	1839.0	3488.0	3678.0	775	1762.8	1857.8	3525.6	3715.6	868	1781.4	1876.4	3562.8	3752.8
588	1725.4	1820.4	3450.8	3640.8	682	1744.2	1839.2	3488.4	3678.4	776	1763.0	1858.0	3526.0	3716.0	869	1781.6	1876.6	3563.2	3753.2
589	1725.6	1820.6	3451.2	3641.2	683	1744.4	1839.4	3488.8	3678.8	777	1763.2	1858.2	3526.4	3716.4	870	1781.8	1876.8	3563.6	3753.6
590	1725.8	1820.8	3451.6	3641.6	684	1744.6	1839.6	3489.2	3679.2	778	1763.4	1858.4	3526.8	3716.8	871	1782.0	1877.0	3564.0	3754.0
591	1726.0	1821.0	3452.0	3642.0	685	1744.8	1839.8	3489.6	3679.6	779	1763.6	1858.6	3527.2	3717.2	872	1782.2	1877.2	3564.4	3754.4
592	1726.2	1821.2	3452.4	3642.4	686	1745.0	1840.0	3490.0	3680.0	780	1763.8	1858.8	3527.6	3717.6	873	1782.4	1877.4	3564.8	3754.8
593	1726.4	1821.4	3452.8	3642.8	687	1745.2	1840.2	3490.4	3680.4	781	1764.0	1859.0	3528.0	3718.0	874	1782.6	1877.6	3565.2	3755.2
594	1726.6	1821.6	3453.2	3643.2	688	1745.4	1840.4	3490.8	3680.8	782	1764.2	1859.2	3528.4	3718.4	875	1782.8	1877.8	3565.6	3755.6
595	1726.8	1821.8	3453.6	3643.6	689	1745.6	1840.6	3491.2	3681.2	783	1764.4	1859.4	3528.8	3718.8	876	1783.0	1878.0	3566.0	3756.0
596	1727.0	1822.0	3454.0	3644.0	690	1745.8	1840.8	3491.6	3681.6	784	1764.6	1859.6	3529.2	3719.2	877	1783.2	1878.2	3566.4	3756.4
597	1727.2	1822.2	3454.4	3644.4	691	1746.0	1841.0	3492.0	3682.0	785	1764.8	1859.8	3529.6	3719.6	878	1783.4	1878.4	3566.8	3756.8
598	1727.4	1822.4	3454.8	3644.8	692	1746.2	1841.2	3492.4	3682.4	786	1765.0	1860.0	3530.0	3720.0	879	1783.6	1878.6	3567.2	3757.2
599	1727.6	1822.6	3455.2	3645.2	693	1746.4	1841.4	3492.8	3682.8	787	1765.2	1860.2	3530.4	3720.4	880	1783.8	1878.8	3567.6	3757.6
600	1727.8	1822.8	3455.6	3645.6	694	1746.6	1841.6	3493.2	3683.2	788	1765.4	1860.4	3530.8	3720.8	881	1784.0	1879.0	3568.0	3758.0
601	1728.0	1823.0	3456.0	3646.0	695	1746.8	1841.8	3493.6	3683.6	789	1765.6	1860.6	3531.2	3721.2	882	1784.2	1879.2	3568.4	3758.4
602	1728.2	1823.2	3456.4	3646.4	696	1747.0	1842.0	3494.0	3684.0	790	1765.8	1860.8	3531.6	3721.6	883	1784.4	1879.4	3568.8	3758.8
603	1728.4	1823.4	3456.8	3646.8	697	1747.2	1842.2	3494.4	3684.4	791	1766.0	1861.0	3532.0	3722.0	884	1784.6	1879.6	3569.2	3759.2
604	1728.6	1823.6	3457.2	3647.2	698	1747.4	1842.4	3494.8	3684.8	792	1766.2	1861.2	3532.4	3722.4	885	1784.8	1879.8	3569.6	3759.6
605	1728.8	1823.8	3457.6	3647.6	699	1747.6	1842.6	3495.2	3685.2										

GSM1900 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
512	1850,2	1930,2	3700,4	3860,4	606	1869,0	1949,0	3738,0	3898,0	700	1887,8	1967,8	3775,6	3935,6	794	1906,6	1986,6	3813,2	3973,2
513	1850,4	1930,4	3700,8	3860,8	607	1869,2	1949,2	3738,4	3898,4	701	1888,0	1968,0	3776,0	3936,0	795	1906,8	1986,8	3813,6	3973,6
514	1850,6	1930,6	3701,2	3861,2	608	1869,4	1949,4	3738,8	3898,8	702	1888,2	1968,2	3776,4	3936,4	796	1907,0	1987,0	3814,0	3974,0
515	1850,8	1930,8	3701,6	3861,6	609	1869,6	1949,6	3739,2	3899,2	703	1888,4	1968,4	3776,8	3936,8	797	1907,2	1987,2	3814,4	3974,4
516	1851,0	1931,0	3702,0	3862,0	610	1869,8	1949,8	3739,6	3899,6	704	1888,6	1968,6	3777,2	3937,2	798	1907,4	1987,4	3814,8	3974,8
517	1851,2	1931,2	3702,4	3862,4	611	1870,0	1950,0	3740,0	3900,0	705	1888,8	1968,8	3777,6	3937,6	799	1907,6	1987,6	3815,2	3975,2
518	1851,4	1931,4	3702,8	3862,8	612	1870,2	1950,2	3740,4	3900,4	706	1889,0	1969,0	3778,0	3938,0	800	1907,8	1987,8	3815,6	3975,6
519	1851,6	1931,6	3703,2	3863,2	613	1870,4	1950,4	3740,8	3900,8	707	1889,2	1969,2	3778,4	3938,4	801	1908,0	1988,0	3816,0	3976,0
520	1851,8	1931,8	3703,6	3863,6	614	1870,6	1950,6	3741,2	3901,2	708	1889,4	1969,4	3778,8	3938,8	802	1908,2	1988,2	3816,4	3976,4
521	1852,0	1932,0	3704,0	3864,0	615	1870,8	1950,8	3741,6	3901,6	709	1889,6	1969,6	3779,2	3939,2	803	1908,4	1988,4	3816,8	3976,8
522	1852,2	1932,2	3704,4	3864,4	616	1871,0	1951,0	3742,0	3902,0	710	1889,8	1969,8	3779,6	3939,6	804	1908,6	1988,6	3817,2	3977,2
523	1852,4	1932,4	3704,8	3864,8	617	1871,2	1951,2	3742,4	3902,4	711	1890,0	1970,0	3780,0	3940,0	805	1908,8	1988,8	3817,6	3977,6
524	1852,6	1932,6	3705,2	3865,2	618	1871,4	1951,4	3742,8	3902,8	712	1890,2	1970,2	3780,4	3940,4	806	1909,0	1989,0	3818,0	3978,0
525	1852,8	1932,8	3705,6	3865,6	619	1871,6	1951,6	3743,2	3903,2	713	1890,4	1970,4	3780,8	3940,8	807	1909,2	1989,2	3818,4	3978,4
526	1853,0	1933,0	3706,0	3866,0	620	1871,8	1951,8	3743,6	3903,6	714	1890,6	1970,6	3781,2	3941,2	808	1909,4	1989,4	3818,8	3978,8
527	1853,2	1933,2	3706,4	3866,4	621	1872,0	1952,0	3744,0	3904,0	715	1890,8	1970,8	3781,6	3941,6	809	1909,6	1989,6	3819,2	3979,2
528	1853,4	1933,4	3706,8	3866,8	622	1872,2	1952,2	3744,4	3904,4	716	1891,0	1971,0	3782,0	3942,0	810	1909,8	1989,8	3819,6	3979,6
529	1853,6	1933,6	3707,2	3867,2	623	1872,4	1952,4	3744,8	3904,8	717	1891,2	1971,2	3782,4	3942,4					
530	1853,8	1933,8	3707,6	3867,6	624	1872,6	1952,6	3745,2	3905,2	718	1891,4	1971,4	3782,8	3942,8					
531	1854,0	1934,0	3708,0	3868,0	625	1872,8	1952,8	3745,6	3905,6	719	1891,6	1971,6	3783,2	3943,2					
532	1854,2	1934,2	3708,4	3868,4	626	1873,0	1953,0	3746,0	3906,0	720	1891,8	1971,8	3783,6	3943,6					
533	1854,4	1934,4	3708,8	3868,8	627	1873,2	1953,2	3746,4	3906,4	721	1892,0	1972,0	3784,0	3944,0					
534	1854,6	1934,6	3709,2	3869,2	628	1873,4	1953,4	3746,8	3906,8	722	1892,2	1972,2	3784,4	3944,4					
535	1854,8	1934,8	3709,6	3869,6	629	1873,6	1953,6	3747,2	3907,2	723	1892,4	1972,4	3784,8	3944,8					
536	1855,0	1935,0	3710,0	3870,0	630	1873,8	1953,8	3747,6	3907,6	724	1892,6	1972,6	3785,2	3945,2					
537	1855,2	1935,2	3710,4	3870,4	631	1874,0	1954,0	3748,0	3908,0	725	1892,8	1972,8	3785,6	3945,6					
538	1855,4	1935,4	3710,8	3870,8	632	1874,2	1954,2	3748,4	3908,4	726	1893,0	1973,0	3786,0	3946,0					
539	1855,6	1935,6	3711,2	3871,2	633	1874,4	1954,4	3748,8	3908,8	727	1893,2	1973,2	3786,4	3946,4					
540	1855,8	1935,8	3711,6	3871,6	634	1874,6	1954,6	3749,2	3909,2	728	1893,4	1973,4	3786,8	3946,8					
541	1856,0	1936,0	3712,0	3872,0	635	1874,8	1954,8	3749,6	3909,6	729	1893,6	1973,6	3787,2	3947,2					
542	1856,2	1936,2	3712,4	3872,4	636	1875,0	1955,0	3750,0	3910,0	730	1893,8	1973,8	3787,6	3947,6					
543	1856,4	1936,4	3712,8	3872,8	637	1875,2	1955,2	3750,4	3910,4	731	1894,0	1974,0	3788,0	3948,0					
544	1856,6	1936,6	3713,2	3873,2	638	1875,4	1955,4	3750,8	3910,8	732	1894,2	1974,2	3788,4	3948,4					
545	1856,8	1936,8	3713,6	3873,6	639	1875,6	1955,6	3751,2	3911,2	733	1894,4	1974,4	3788,8	3948,8					
546	1857,0	1937,0	3714,0	3874,0	640	1875,8	1955,8	3751,6	3911,6	734	1894,6	1974,6	3789,2	3949,2					
547	1857,2	1937,2	3714,4	3874,4	641	1876,0	1956,0	3752,0	3912,0	735	1894,8	1974,8	3789,6	3949,6					
548	1857,4	1937,4	3714,8	3874,8	642	1876,2	1956,2	3752,4	3912,4	736	1895,0	1975,0	3790,0	3950,0					
549	1857,6	1937,6	3715,2	3875,2	643	1876,4	1956,4	3752,8	3912,8	737	1895,2	1975,2	3790,4	3950,4					
550	1857,8	1937,8	3715,6	3875,6	644	1876,6	1956,6	3753,2	3913,2	738	1895,4	1975,4	3790,8	3950,8					
551	1858,0	1938,0	3716,0	3876,0	645	1876,8	1956,8	3753,6	3913,6	739	1895,6	1975,6	3791,2	3951,2					
552	1858,2	1938,2	3716,4	3876,4	646	1877,0	1957,0	3754,0	3914,0	740	1895,8	1975,8	3791,6	3951,6					
553	1858,4	1938,4	3716,8	3876,8	647	1877,2	1957,2	3754,4	3914,4	741	1896,0	1976,0	3792,0	3952,0					
554	1858,6	1938,6	3717,2	3877,2	648	1877,4	1957,4	3754,8	3914,8	742	1896,2	1976,2	3792,4	3952,4					
555	1858,8	1938,8	3717,6	3877,6	649	1877,6	1957,6	3755,2	3915,2	743	1896,4	1976,4	3792,8	3952,8					
556	1859,0	1939,0	3718,0	3878,0	650	1877,8	1957,8	3755,6	3915,6	744	1896,6	1976,6	3793,2	3953,2					
557	1859,2	1939,2	3718,4	3878,4	651	1878,0	1958,0	3756,0	3916,0	745	1896,8	1976,8	3793,6	3953,6					
558	1859,4	1939,4	3718,8	3878,8	652	1878,2	1958,2	3756,4	3916,4	746	1897,0	1977,0	3794,0	3954,0					
559	1859,6	1939,6	3719,2	3879,2	653	1878,4	1958,4	3756,8	3916,8	747	1897,2	1977,2	3794,4	3954,4					
560	1859,8	1939,8	3719,6	3879,6	654	1878,6	1958,6	3757,2	3917,2	748	1897,4	1977,4	3794,8	3954,8					
561	1860,0	1940,0	3720,0	3880,0	655	1878,8	1958,8	3757,6	3917,6	749	1897,6	1977,6	3795,2	3955,2					
562	1860,2	1940,2	3720,4	3880,4	656	1879,0	1959,0	3758,0	3918,0	750	1897,8	1977,8	3795,6	3955,6					
563	1860,4	1940,4	3720,8	3880,8	657	1879,2	1959,2	3758,4	3918,4	751	1898,0	1978,0	3796,0	3956,0					
564	1860,6	1940,6	3721,2	3881,2	658	1879,4	1959,4	3758,8	3918,8	752	1898,2	1978,2	3796,4	3956,4					
565	1860,8	1940,8	3721,6	3881,6	659	1879,6	1959,6	3759,2	3919,2	753	1898,4	1978,4	3796,8	3956,8					
566	1861,0	1941,0	3722,0	3882,0	660	1879,8	1959,8	3759,6	3919,6	754	1898,6	1978,6	3797,2	3957,2					
567	1861,2	1941,2	3722,4	3882,4	661	1880,0	1960,0	3760,0	3920,0	755	1898,8	1978,8	3797,6	3957,6					
568	1861,4	1941,4	3722,8	3882,8	662	1880,2	1960,2	3760,4	3920,4	756	1899,0	1979,0	3798,0	3958,0					
569	1861,6	1941,6	3723,2	3883,2	663	1880,4	1960,4	3760,8	3920,8	757	1899,2	1979,2	3798,4	3958,4					
570	1861,8	1941,8	3723,6	3883,6	664	1880,6	1960,6	3761,2	3921,2	758	1899,4	1979,4	3798,8	3958,8					
571	1862,0	1942,0	3724,0	3884,0	665	1880,8	1960,8	3761,6	3921,6	759	1899,6	1979,6	3799,2	3959,2					
572	1862,2	1942,2	3724,4	3884,4	666	1881,0	1961,0	3762,0	3922,0	760	1899,8	1979,8	3799,6	3959,6					
573	1862,4	1942,4	3724,8	3884,8	667	1881,2	1961,2	3762,4	3922,4	761	1900,0	1980,0	3800,0	3960,0					
574	1862,6	1942,6	3725,2	3885,2	668	1881,4	1961,4	3762,8	3922,8	762	1900,2	1980,2	3800,4	3960,4					
575	1862,8	1942,8	3725,6	3885,6	669	1881,6	1961,6	3763,2	3923,2	763	1900,4	1980,4	3800,8	3960,8					
576	1863,0	1943,0	3726,0	3886,0	670	1881,8	1961,8	3763,6	3923,6	764	1900,6	1980,6	3801,2	3961,2					
577	1863,2	1943,2	3726,4	3886,4	671	1882,0	1962,0	3764,0	3924,0	765	1900,8	1980,8	3801,6	3961,6					
578	1863,4	1943,4	3726,8	3886,8	672	1882,2	1962,2	3764,4	3924,4	766	1901,0	1981,0	3802,0	3962,0					
579	1863,6	1943,6	3727,2	3887,2	673	1882,4	1962,4	3764,8	3924,8	767	1901,2	1981,2	3802,4	3962,4					
580	1863,8	1943,8	3727,6	3887,6	674	1882,6	1962,6	3765,2	3925,2	768	1901,4	1981,4	3802,8	3962,8					
581	1864,0	1944,0	3728,0	3888,0	675	1882,8	1962,8	3765,6	3925,6	769	1901,6	1981,6	3803,2	3963,2					
582	1864,2	1944,2	3728,4	3888,4	676	1883,0	1963,0	3766,0	3926,0	770	1901,8	1981,8	3803,6	3963,6					
583	1864,4	1944,4	3728,8	3888,8	677	1883,2	1963,2	3766,4	3926,4	771	1902,0	1982,0	3804,0	3964,0					
584	1864,6	1944,6	3729,2	3889,2	678	1883,4	1963,4	3766,8	3926,8	772	1902,2	1982,2	3804,4	3964,4					
585	1864,8	1944,8	3729,6	3889,6	679	1883,6	1963,6	3767,2	3927,2	773	1902,4	1982,4	3804,8	3964,8					
586	1865,0	1945,0	3730,0	3890,0	680	1883,8	1963,8	3767,6	3927,6	774	1902,6	1982,6	3805,2	3965,2					
587	1865,2	1945,2	3730,4	3890,4	681	1884,0	1964,0	3768,0	3928,0	775	1902,8	1982,8	3805,6	3965,6					
588	1865,4	1945,4	3730,8	3890,8	682	1884,2	1964,2	3768,4	3928,4	776	1903,0	1983,0	3806,0	3966,0					
589	1865,6	1945,6	3731,2	3891,2	683	1884,4	1964,4	3768,8	3928,8	777	1903,2	1983,2	3806,4	3966,4					
590	1865,8	1945,8	3731,6	3891,6	684	1884,6	1964,6	3769,2	3929,2	778	1903,4	1983,4	3806,8	3966,8					
591	1866,0	1946,0	3732,0	3892,0	685	1884,8	1964,8	3769,6	3929,6	779	1903,6	1983,6	3807,2	3967,2					
592	1866,2	1946,2	3732,4	3892,4	686	1885,0	1965,0	3770,0	3930,0	780	1903,8	1983,8	3807,6	3967,6					
593	1866,4	1946,4	3732,8	3892,8	687	1885,2	1965,2	3770,4	3930,4	781	1904,0	1984,0	3808,0	3968,0					
594	1866,6	1946,6	3733,2	3893,2	688	1885,4	1965,4	3770,8	3930,8	782	1904,2	1984,2	3808,4	3968,4					
595	1866,8	1946,8	3733,6	3893,6	689	1885,6	1965,6	3771,2	3931,2	783	1904,4	1984,4	3808,8	3968,8					
596	1867,0	1947,0	3734,0	3894,0	690	1885,8	1965,8	3771,6	3931,6	784	1904,6	1984,6	3809,2	3969,2					
597	1867,2	1947,2	3734,4	3894,4	691	1886,0	1966,0	3772,0	3932,0	785	1904,8	1984,8	3809,6	3969,6					
598	1867,4	1947,4	3734,8	3894,8	692	1886,2	1966,2	3772,4	3932,4	786	1905,0	1985,0	3810,0	3970,0					
599	1867,6	1947,6	3735,2	3895,2	693	1886,4	1966,4	3772,8	3932,8	787	1905,2	1985,2	3810,4	3970,4					
600	1867,8	1947,8	3735,6	3895,6	694	1886,6	1966,6	3773,2	3933,2	788	1905,4	1985,4	3810,8	3970,8					
601	1868,0	1948,0	3736,0	3896,0	695	1886,8	1966,8	3773,6	3933,6	789	1905,6	1985,6	3811,2	3971,2					
602	1868,2	1948,2	3736,4	3896,4	696	1887,0	1967,0	3774,0	3934,0	790	1905,8	1985,8	3811,6	3971,6					
603	1868,4	1948,4	3736,8	3896,8	697	1887,2	1967,2	3774,4	3934,4	791	1906,0	1986,0	3812,0	3972,0					
604	1868,6	1948,6	3737,2	3897,2	698	1887,4	1967,4	3774,8	3934,8	792	1906,2	1986,2	3812,4	3972,4					
605	1868,8	1948,8	3737,6	3897,6	699	1887,6	1967,6	3775,2	3935,2	793	1906,4	1986,4	3812,8	3972,8					

WCDMA 2100 Rx frequencies

Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX
10562	2112.4	4224.8	10625	2125	4250	10688	2137.6	4275.2	10751	2150.2	4300.4	10814	2162.8	4325.6
10563	2112.6	4225.2	10626	2125.2	4250.4	10689	2137.8	4275.6	10752	2150.4	4300.8	10815	2163	4326
10564	2112.8	4225.6	10627	2125.4	4250.8	10690	2138	4276	10753	2150.6	4301.2	10816	2163.2	4326.4
10565	2113	4226	10628	2125.6	4251.2	10691	2138.2	4276.4	10754	2150.8	4301.6	10817	2163.4	4326.8
10566	2113.2	4226.4	10629	2125.8	4251.6	10692	2138.4	4276.8	10755	2151	4302	10818	2163.6	4327.2
10567	2113.4	4226.8	10630	2126	4252	10693	2138.6	4277.2	10756	2151.2	4302.4	10819	2163.8	4327.6
10568	2113.6	4227.2	10631	2126.2	4252.4	10694	2138.8	4277.6	10757	2151.4	4302.8	10820	2164	4328
10569	2113.8	4227.6	10632	2126.4	4252.8	10695	2139	4278	10758	2151.6	4303.2	10821	2164.2	4328.4
10570	2114	4228	10633	2126.6	4253.2	10696	2139.2	4278.4	10759	2151.8	4303.6	10822	2164.4	4328.8
10571	2114.2	4228.4	10634	2126.8	4253.6	10697	2139.4	4278.8	10760	2152	4304	10823	2164.6	4329.2
10572	2114.4	4228.8	10635	2127	4254	10698	2139.6	4279.2	10761	2152.2	4304.4	10824	2164.8	4329.6
10573	2114.6	4229.2	10636	2127.2	4254.4	10699	2139.8	4279.6	10762	2152.4	4304.8	10825	2165	4330
10574	2114.8	4229.6	10637	2127.4	4254.8	10700	2140	4280	10763	2152.6	4305.2	10826	2165.2	4330.4
10575	2115	4230	10638	2127.6	4255.2	10701	2140.2	4280.4	10764	2152.8	4305.6	10827	2165.4	4330.8
10576	2115.2	4230.4	10639	2127.8	4255.6	10702	2140.4	4280.8	10765	2153	4306	10828	2165.6	4331.2
10577	2115.4	4230.8	10640	2128	4256	10703	2140.6	4281.2	10766	2153.2	4306.4	10829	2165.8	4331.6
10578	2115.6	4231.2	10641	2128.2	4256.4	10704	2140.8	4281.6	10767	2153.4	4306.8	10830	2166	4332
10579	2115.8	4231.6	10642	2128.4	4256.8	10705	2141	4282	10768	2153.6	4307.2	10831	2166.2	4332.4
10580	2116	4232	10643	2128.6	4257.2	10706	2141.2	4282.4	10769	2153.8	4307.6	10832	2166.4	4332.8
10581	2116.2	4232.4	10644	2128.8	4257.6	10707	2141.4	4282.8	10770	2154	4308	10833	2166.6	4333.2
10582	2116.4	4232.8	10645	2129	4258	10708	2141.6	4283.2	10771	2154.2	4308.4	10834	2166.8	4333.6
10583	2116.6	4233.2	10646	2129.2	4258.4	10709	2141.8	4283.6	10772	2154.4	4308.8	10835	2167	4334
10584	2116.8	4233.6	10647	2129.4	4258.8	10710	2142	4284	10773	2154.6	4309.2	10836	2167.2	4334.4
10585	2117	4234	10648	2129.6	4259.2	10711	2142.2	4284.4	10774	2154.8	4309.6	10837	2167.4	4334.8
10586	2117.2	4234.4	10649	2129.8	4259.6	10712	2142.4	4284.8	10775	2155	4310	10838	2167.6	4335.2
10587	2117.4	4234.8	10650	2130	4260	10713	2142.6	4285.2	10776	2155.2	4310.4			
10588	2117.6	4235.2	10651	2130.2	4260.4	10714	2142.8	4285.6	10777	2155.4	4310.8			
10589	2117.8	4235.6	10652	2130.4	4260.8	10715	2143	4286	10778	2155.6	4311.2			
10590	2118	4236	10653	2130.6	4261.2	10716	2143.2	4286.4	10779	2155.8	4311.6			
10591	2118.2	4236.4	10654	2130.8	4261.6	10717	2143.4	4286.8	10780	2156	4312			
10592	2118.4	4236.8	10655	2131	4262	10718	2143.6	4287.2	10781	2156.2	4312.4			
10593	2118.6	4237.2	10656	2131.2	4262.4	10719	2143.8	4287.6	10782	2156.4	4312.8			
10594	2118.8	4237.6	10657	2131.4	4262.8	10720	2144	4288	10783	2156.6	4313.2			
10595	2119	4238	10658	2131.6	4263.2	10721	2144.2	4288.4	10784	2156.8	4313.6			
10596	2119.2	4238.4	10659	2131.8	4263.6	10722	2144.4	4288.8	10785	2157	4314			
10597	2119.4	4238.8	10660	2132	4264	10723	2144.6	4289.2	10786	2157.2	4314.4			
10598	2119.6	4239.2	10661	2132.2	4264.4	10724	2144.8	4289.6	10787	2157.4	4314.8			
10599	2119.8	4239.6	10662	2132.4	4264.8	10725	2145	4290	10788	2157.6	4315.2			
10600	2120	4240	10663	2132.6	4265.2	10726	2145.2	4290.4	10789	2157.8	4315.6			
10601	2120.2	4240.4	10664	2132.8	4265.6	10727	2145.4	4290.8	10790	2158	4316			
10602	2120.4	4240.8	10665	2133	4266	10728	2145.6	4291.2	10791	2158.2	4316.4			
10603	2120.6	4241.2	10666	2133.2	4266.4	10729	2145.8	4291.6	10792	2158.4	4316.8			
10604	2120.8	4241.6	10667	2133.4	4266.8	10730	2146	4292	10793	2158.6	4317.2			
10605	2121	4242	10668	2133.6	4267.2	10731	2146.2	4292.4	10794	2158.8	4317.6			
10606	2121.2	4242.4	10669	2133.8	4267.6	10732	2146.4	4292.8	10795	2159	4318			
10607	2121.4	4242.8	10670	2134	4268	10733	2146.6	4293.2	10796	2159.2	4318.4			
10608	2121.6	4243.2	10671	2134.2	4268.4	10734	2146.8	4293.6	10797	2159.4	4318.8			
10609	2121.8	4243.6	10672	2134.4	4268.8	10735	2147	4294	10798	2159.6	4319.2			
10610	2122	4244	10673	2134.6	4269.2	10736	2147.2	4294.4	10799	2159.8	4319.6			
10611	2122.2	4244.4	10674	2134.8	4269.6	10737	2147.4	4294.8	10800	2160	4320			
10612	2122.4	4244.8	10675	2135	4270	10738	2147.6	4295.2	10801	2160.2	4320.4			
10613	2122.6	4245.2	10676	2135.2	4270.4	10739	2147.8	4295.6	10802	2160.4	4320.8			
10614	2122.8	4245.6	10677	2135.4	4270.8	10740	2148	4296	10803	2160.6	4321.2			
10615	2123	4246	10678	2135.6	4271.2	10741	2148.2	4296.4	10804	2160.8	4321.6			
10616	2123.2	4246.4	10679	2135.8	4271.6	10742	2148.4	4296.8	10805	2161	4322			
10617	2123.4	4246.8	10680	2136	4272	10743	2148.6	4297.2	10806	2161.2	4322.4			
10618	2123.6	4247.2	10681	2136.2	4272.4	10744	2148.8	4297.6	10807	2161.4	4322.8			
10619	2123.8	4247.6	10682	2136.4	4272.8	10745	2149	4298	10808	2161.6	4323.2			
10620	2124	4248	10683	2136.6	4273.2	10746	2149.2	4298.4	10809	2161.8	4323.6			
10621	2124.2	4248.4	10684	2136.8	4273.6	10747	2149.4	4298.8	10810	2162	4324			
10622	2124.4	4248.8	10685	2137	4274	10748	2149.6	4299.2	10811	2162.2	4324.4			
10623	2124.6	4249.2	10686	2137.2	4274.4	10749	2149.8	4299.6	10812	2162.4	4324.8			
10624	2124.8	4249.6	10687	2137.4	4274.8	10750	2150	4300	10813	2162.6	4325.2			

WCDMA 2100 Tx frequencies

Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx
9612	1922.4	3844.8	9671	1934.2	3868.4	9730	1946	3892	9789	1957.8	3915.6	9848	1969.6	3939.2
9613	1922.6	3845.2	9672	1934.4	3868.8	9731	1946.2	3892.4	9790	1958	3916	9849	1969.8	3939.6
9614	1922.8	3845.6	9673	1934.6	3869.2	9732	1946.4	3892.8	9791	1958.2	3916.4	9850	1970	3940
9615	1923	3846	9674	1934.8	3869.6	9733	1946.6	3893.2	9792	1958.4	3916.8	9851	1970.2	3940.4
9616	1923.2	3846.4	9675	1935	3870	9734	1946.8	3893.6	9793	1958.6	3917.2	9852	1970.4	3940.8
9617	1923.4	3846.8	9676	1935.2	3870.4	9735	1947	3894	9794	1958.8	3917.6	9853	1970.6	3941.2
9618	1923.6	3847.2	9677	1935.4	3870.8	9736	1947.2	3894.4	9795	1959	3918	9854	1970.8	3941.6
9619	1923.8	3847.6	9678	1935.6	3871.2	9737	1947.4	3894.8	9796	1959.2	3918.4	9855	1971	3942
9620	1924	3848	9679	1935.8	3871.6	9738	1947.6	3895.2	9797	1959.4	3918.8	9856	1971.2	3942.4
9621	1924.2	3848.4	9680	1936	3872	9739	1947.8	3895.6	9798	1959.6	3919.2	9857	1971.4	3942.8
9622	1924.4	3848.8	9681	1936.2	3872.4	9740	1948	3896	9799	1959.8	3919.6	9858	1971.6	3943.2
9623	1924.6	3849.2	9682	1936.4	3872.8	9741	1948.2	3896.4	9800	1960	3920	9859	1971.8	3943.6
9624	1924.8	3849.6	9683	1936.6	3873.2	9742	1948.4	3896.8	9801	1960.2	3920.4	9860	1972	3944
9625	1925	3850	9684	1936.8	3873.6	9743	1948.6	3897.2	9802	1960.4	3920.8	9861	1972.2	3944.4
9626	1925.2	3850.4	9685	1937	3874	9744	1948.8	3897.6	9803	1960.6	3921.2	9862	1972.4	3944.8
9627	1925.4	3850.8	9686	1937.2	3874.4	9745	1949	3898	9804	1960.8	3921.6	9863	1972.6	3945.2
9628	1925.6	3851.2	9687	1937.4	3874.8	9746	1949.2	3898.4	9805	1961	3922	9864	1972.8	3945.6
9629	1925.8	3851.6	9688	1937.6	3875.2	9747	1949.4	3898.8	9806	1961.2	3922.4	9865	1973	3946
9630	1926	3852	9689	1937.8	3875.6	9748	1949.6	3899.2	9807	1961.4	3922.8	9866	1973.2	3946.4
9631	1926.2	3852.4	9690	1938	3876	9749	1949.8	3899.6	9808	1961.6	3923.2	9867	1973.4	3946.8
9632	1926.4	3852.8	9691	1938.2	3876.4	9750	1950	3900	9809	1961.8	3923.6	9868	1973.6	3947.2
9633	1926.6	3853.2	9692	1938.4	3876.8	9751	1950.2	3900.4	9810	1962	3924	9869	1973.8	3947.6
9634	1926.8	3853.6	9693	1938.6	3877.2	9752	1950.4	3900.8	9811	1962.2	3924.4	9870	1974	3948
9635	1927	3854	9694	1938.8	3877.6	9753	1950.6	3901.2	9812	1962.4	3924.8	9871	1974.2	3948.4
9636	1927.2	3854.4	9695	1939	3878	9754	1950.8	3901.6	9813	1962.6	3925.2	9872	1974.4	3948.8
9637	1927.4	3854.8	9696	1939.2	3878.4	9755	1951	3902	9814	1962.8	3925.6	9873	1974.6	3949.2
9638	1927.6	3855.2	9697	1939.4	3878.8	9756	1951.2	3902.4	9815	1963	3926	9874	1974.8	3949.6
9639	1927.8	3855.6	9698	1939.6	3879.2	9757	1951.4	3902.8	9816	1963.2	3926.4	9875	1975	3950
9640	1928	3856	9699	1939.8	3879.6	9758	1951.6	3903.2	9817	1963.4	3926.8	9876	1975.2	3950.4
9641	1928.2	3856.4	9700	1940	3880	9759	1951.8	3903.6	9818	1963.6	3927.2	9877	1975.4	3950.8
9642	1928.4	3856.8	9701	1940.2	3880.4	9760	1952	3904	9819	1963.8	3927.6	9878	1975.6	3951.2
9643	1928.6	3857.2	9702	1940.4	3880.8	9761	1952.2	3904.4	9820	1964	3928	9879	1975.8	3951.6
9644	1928.8	3857.6	9703	1940.6	3881.2	9762	1952.4	3904.8	9821	1964.2	3928.4	9880	1976	3952
9645	1929	3858	9704	1940.8	3881.6	9763	1952.6	3905.2	9822	1964.4	3928.8	9881	1976.2	3952.4
9646	1929.2	3858.4	9705	1941	3882	9764	1952.8	3905.6	9823	1964.6	3929.2	9882	1976.4	3952.8
9647	1929.4	3858.8	9706	1941.2	3882.4	9765	1953	3906	9824	1964.8	3929.6	9883	1976.6	3953.2
9648	1929.6	3859.2	9707	1941.4	3882.8	9766	1953.2	3906.4	9825	1965	3930	9884	1976.8	3953.6
9649	1929.8	3859.6	9708	1941.6	3883.2	9767	1953.4	3906.8	9826	1965.2	3930.4	9885	1977	3954
9650	1930	3860	9709	1941.8	3883.6	9768	1953.6	3907.2	9827	1965.4	3930.8	9886	1977.2	3954.4
9651	1930.2	3860.4	9710	1942	3884	9769	1953.8	3907.6	9828	1965.6	3931.2	9887	1977.4	3954.8
9652	1930.4	3860.8	9711	1942.2	3884.4	9770	1954	3908	9829	1965.8	3931.6	9888	1977.6	3955.2
9653	1930.6	3861.2	9712	1942.4	3884.8	9771	1954.2	3908.4	9830	1966	3932			
9654	1930.8	3861.6	9713	1942.6	3885.2	9772	1954.4	3908.8	9831	1966.2	3932.4			
9655	1931	3862	9714	1942.8	3885.6	9773	1954.6	3909.2	9832	1966.4	3932.8			
9656	1931.2	3862.4	9715	1943	3886	9774	1954.8	3909.6	9833	1966.6	3933.2			
9657	1931.4	3862.8	9716	1943.2	3886.4	9775	1955	3910	9834	1966.8	3933.6			
9658	1931.6	3863.2	9717	1943.4	3886.8	9776	1955.2	3910.4	9835	1967	3934			
9659	1931.8	3863.6	9718	1943.6	3887.2	9777	1955.4	3910.8	9836	1967.2	3934.4			
9660	1932	3864	9719	1943.8	3887.6	9778	1955.6	3911.2	9837	1967.4	3934.8			
9661	1932.2	3864.4	9720	1944	3888	9779	1955.8	3911.6	9838	1967.6	3935.2			
9662	1932.4	3864.8	9721	1944.2	3888.4	9780	1956	3912	9839	1967.8	3935.6			
9663	1932.6	3865.2	9722	1944.4	3888.8	9781	1956.2	3912.4	9840	1968	3936			
9664	1932.8	3865.6	9723	1944.6	3889.2	9782	1956.4	3912.8	9841	1968.2	3936.4			
9665	1933	3866	9724	1944.8	3889.6	9783	1956.6	3913.2	9842	1968.4	3936.8			
9666	1933.2	3866.4	9725	1945	3890	9784	1956.8	3913.6	9843	1968.6	3937.2			
9667	1933.4	3866.8	9726	1945.2	3890.4	9785	1957	3914	9844	1968.8	3937.6			
9668	1933.6	3867.2	9727	1945.4	3890.8	9786	1957.2	3914.4	9845	1969	3938			
9669	1933.8	3867.6	9728	1945.6	3891.2	9787	1957.4	3914.8	9846	1969.2	3938.4			
9670	1934	3868	9729	1945.8	3891.6	9788	1957.6	3915.2	9847	1969.4	3938.8			

WCDMA 1900 Rx frequencies

Ch	Rx	VCO Rx	Ch	Rx	VCO Rx	Ch	Rx	VCO Rx	Ch	Rx	VCO Rx
9662	1932.4	3864.8	9732	1946.4	3892.8	9801	1960.2	3920.4	9870	1974	3948
412	1932.5	3865	9733	1946.6	3893.2	9802	1960.4	3920.8	9871	1974.2	3948.4
9663	1932.6	3865.2	9734	1946.8	3893.6	9803	1960.6	3921.2	9872	1974.4	3948.8
9664	1932.8	3865.6	9735	1947	3894	9804	1960.8	3921.6	9873	1974.6	3949.2
9665	1933	3866	9736	1947.2	3894.4	9805	1961	3922	9874	1974.8	3949.6
9666	1933.2	3866.4	9737	1947.4	3894.8	9806	1961.2	3922.4	9875	1975	3950
9667	1933.4	3866.8	487	1947.5	3895	9807	1961.4	3922.8	9876	1975.2	3950.4
9668	1933.6	3867.2	9738	1947.6	3895.2	9808	1961.6	3923.2	9877	1975.4	3950.8
9669	1933.8	3867.6	9739	1947.8	3895.6	9809	1961.8	3923.6	9878	1975.6	3951.2
9670	1934	3868	9740	1948	3896	9810	1962	3924	9879	1975.8	3951.6
9671	1934.2	3868.4	9741	1948.2	3896.4	9811	1962.2	3924.4	9880	1976	3952
9672	1934.4	3868.8	9742	1948.4	3896.8	9812	1962.4	3924.8	9881	1976.2	3952.4
9673	1934.6	3869.2	9743	1948.6	3897.2	562	1962.5	3925	9882	1976.4	3952.8
9674	1934.8	3869.6	9744	1948.8	3897.6	9813	1962.6	3925.2	9883	1976.6	3953.2
9675	1935	3870	9745	1949	3898	9814	1962.8	3925.6	9884	1976.8	3953.6
9676	1935.2	3870.4	9746	1949.2	3898.4	9815	1963	3926	9885	1977	3954
9677	1935.4	3870.8	9747	1949.4	3898.8	9816	1963.2	3926.4	9886	1977.2	3954.4
9678	1935.6	3871.2	9748	1949.6	3899.2	9817	1963.4	3926.8	9887	1977.4	3954.8
9679	1935.8	3871.6	9749	1949.8	3899.6	9818	1963.6	3927.2	637	1977.5	3955
9680	1936	3872	9750	1950	3900	9819	1963.8	3927.6	9888	1977.6	3955.2
9681	1936.2	3872.4	9751	1950.2	3900.4	9820	1964	3928	9889	1977.8	3955.6
9682	1936.4	3872.8	9752	1950.4	3900.8	9821	1964.2	3928.4	9890	1978	3956
9683	1936.6	3873.2	9753	1950.6	3901.2	9822	1964.4	3928.8	9891	1978.2	3956.4
9684	1936.8	3873.6	9754	1950.8	3901.6	9823	1964.6	3929.2	9892	1978.4	3956.8
9685	1937	3874	9755	1951	3902	9824	1964.8	3929.6	9893	1978.6	3957.2
9686	1937.2	3874.4	9756	1951.2	3902.4	9825	1965	3930	9894	1978.8	3957.6
9687	1937.4	3874.8	9757	1951.4	3902.8	9826	1965.2	3930.4	9895	1979	3958
437	1937.5	3875	9758	1951.6	3903.2	9827	1965.4	3930.8	9896	1979.2	3958.4
9688	1937.6	3875.2	9759	1951.8	3903.6	9828	1965.6	3931.2	9897	1979.4	3958.8
9689	1937.8	3875.6	9760	1952	3904	9829	1965.8	3931.6	9898	1979.6	3959.2
9690	1938	3876	9761	1952.2	3904.4	9830	1966	3932	9899	1979.8	3959.6
9691	1938.2	3876.4	9762	1952.4	3904.8	9831	1966.2	3932.4	9900	1980	3960
9692	1938.4	3876.8	512	1952.5	3905	9832	1966.4	3932.8	9901	1980.2	3960.4
9693	1938.6	3877.2	9763	1952.6	3905.2	9833	1966.6	3933.2	9902	1980.4	3960.8
9694	1938.8	3877.6	9764	1952.8	3905.6	9834	1966.8	3933.6	9903	1980.6	3961.2
9695	1939	3878	9765	1953	3906	9835	1967	3934	9904	1980.8	3961.6
9696	1939.2	3878.4	9766	1953.2	3906.4	9836	1967.2	3934.4	9905	1981	3962
9697	1939.4	3878.8	9767	1953.4	3906.8	9837	1967.4	3934.8	9906	1981.2	3962.4
9698	1939.6	3879.2	9768	1953.6	3907.2	587	1967.5	3935	9907	1981.4	3962.8
9699	1939.8	3879.6	9769	1953.8	3907.6	9838	1967.6	3935.2	9908	1981.6	3963.2
9700	1940	3880	9770	1954	3908	9839	1967.8	3935.6	9909	1981.8	3963.6
9701	1940.2	3880.4	9771	1954.2	3908.4	9840	1968	3936	9910	1982	3964
9702	1940.4	3880.8	9772	1954.4	3908.8	9841	1968.2	3936.4	9911	1982.2	3964.4
9703	1940.6	3881.2	9773	1954.6	3909.2	9842	1968.4	3936.8	9912	1982.4	3964.8
9704	1940.8	3881.6	9774	1954.8	3909.6	9843	1968.6	3937.2	662	1982.5	3965
9705	1941	3882	9775	1955	3910	9844	1968.8	3937.6	9913	1982.6	3965.2
9706	1941.2	3882.4	9776	1955.2	3910.4	9845	1969	3938	9914	1982.8	3965.6
9707	1941.4	3882.8	9777	1955.4	3910.8	9846	1969.2	3938.4	9915	1983	3966
9708	1941.6	3883.2	9778	1955.6	3911.2	9847	1969.4	3938.8	9916	1983.2	3966.4
9709	1941.8	3883.6	9779	1955.8	3911.6	9848	1969.6	3939.2	9917	1983.4	3966.8
9710	1942	3884	9780	1956	3912	9849	1969.8	3939.6	9918	1983.6	3967.2
9711	1942.2	3884.4	9781	1956.2	3912.4	9850	1970	3940	9919	1983.8	3967.6
9712	1942.4	3884.8	9782	1956.4	3912.8	9851	1970.2	3940.4	9920	1984	3968
462	1942.5	3885	9783	1956.6	3913.2	9852	1970.4	3940.8	9921	1984.2	3968.4
9713	1942.6	3885.2	9784	1956.8	3913.6	9853	1970.6	3941.2	9922	1984.4	3968.8
9714	1942.8	3885.6	9785	1957	3914	9854	1970.8	3941.6	9923	1984.6	3969.2
9715	1943	3886	9786	1957.2	3914.4	9855	1971	3942	9924	1984.8	3969.6
9716	1943.2	3886.4	9787	1957.4	3914.8	9856	1971.2	3942.4	9925	1985	3970
9717	1943.4	3886.8	537	1957.5	3915	9857	1971.4	3942.8	9926	1985.2	3970.4
9718	1943.6	3887.2	9788	1957.6	3915.2	9858	1971.6	3943.2	9927	1985.4	3970.8
9719	1943.8	3887.6	9789	1957.8	3915.6	9859	1971.8	3943.6	9928	1985.6	3971.2
9720	1944	3888	9790	1958	3916	9860	1972	3944	9929	1985.8	3971.6
9721	1944.2	3888.4	9791	1958.2	3916.4	9861	1972.2	3944.4	9930	1986	3972
9722	1944.4	3888.8	9792	1958.4	3916.8	9862	1972.4	3944.8	9931	1986.2	3972.4
9723	1944.6	3889.2	9793	1958.6	3917.2	612	1972.5	3945	9932	1986.4	3972.8
9724	1944.8	3889.6	9794	1958.8	3917.6	9863	1972.6	3945.2	9933	1986.6	3973.2
9725	1945	3890	9795	1959	3918	9864	1972.8	3945.6	9934	1986.8	3973.6
9726	1945.2	3890.4	9796	1959.2	3918.4	9865	1973	3946	9935	1987	3974
9727	1945.4	3890.8	9797	1959.4	3918.8	9866	1973.2	3946.4	9936	1987.2	3974.4
9728	1945.6	3891.2	9798	1959.6	3919.2	9867	1973.4	3946.8	9937	1987.4	3974.8
9729	1945.8	3891.6	9799	1959.8	3919.6	9868	1973.6	3947.2	687	1987.5	3975
9730	1946	3892	9800	1960	3920	9869	1973.8	3947.6	9938	1987.6	3975.2
9731	1946.2	3892.4									

WCDMA 1900 Tx frequencies

Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx
9262	1852.4	3704.8	9332	1866.4	3732.8	9401	1880.2	3760.4	9470	1894	3788
12	1852.5	3705	9333	1866.6	3733.2	9402	1880.4	3760.8	9471	1894.2	3788.4
9263	1852.6	3705.2	9334	1866.8	3733.6	9403	1880.6	3761.2	9472	1894.4	3788.8
9264	1852.8	3705.6	9335	1867	3734	9404	1880.8	3761.6	9473	1894.6	3789.2
9265	1853	3706	9336	1867.2	3734.4	9405	1881	3762	9474	1894.8	3789.6
9266	1853.2	3706.4	9337	1867.4	3734.8	9406	1881.2	3762.4	9475	1895	3790
9267	1853.4	3706.8	87	1867.5	3735	9407	1881.4	3762.8	9476	1895.2	3790.4
9268	1853.6	3707.2	9338	1867.6	3735.2	9408	1881.6	3763.2	9477	1895.4	3790.8
9269	1853.8	3707.6	9339	1867.8	3735.6	9409	1881.8	3763.6	9478	1895.6	3791.2
9270	1854	3708	9340	1868	3736	9410	1882	3764	9479	1895.8	3791.6
9271	1854.2	3708.4	9341	1868.2	3736.4	9411	1882.2	3764.4	9480	1896	3792
9272	1854.4	3708.8	9342	1868.4	3736.8	9412	1882.4	3764.8	9481	1896.2	3792.4
9273	1854.6	3709.2	9343	1868.6	3737.2	162	1882.5	3765	9482	1896.4	3792.8
9274	1854.8	3709.6	9344	1868.8	3737.6	9413	1882.6	3765.2	9483	1896.6	3793.2
9275	1855	3710	9345	1869	3738	9414	1882.8	3765.6	9484	1896.8	3793.6
9276	1855.2	3710.4	9346	1869.2	3738.4	9415	1883	3766	9485	1897	3794
9277	1855.4	3710.8	9347	1869.4	3738.8	9416	1883.2	3766.4	9486	1897.2	3794.4
9278	1855.6	3711.2	9348	1869.6	3739.2	9417	1883.4	3766.8	9487	1897.4	3794.8
9279	1855.8	3711.6	9349	1869.8	3739.6	9418	1883.6	3767.2	237	1897.5	3795
9280	1856	3712	9350	1870	3740	9419	1883.8	3767.6	9488	1897.6	3795.2
9281	1856.2	3712.4	9351	1870.2	3740.4	9420	1884	3768	9489	1897.8	3795.6
9282	1856.4	3712.8	9352	1870.4	3740.8	9421	1884.2	3768.4	9490	1898	3796
9283	1856.6	3713.2	9353	1870.6	3741.2	9422	1884.4	3768.8	9491	1898.2	3796.4
9284	1856.8	3713.6	9354	1870.8	3741.6	9423	1884.6	3769.2	9492	1898.4	3796.8
9285	1857	3714	9355	1871	3742	9424	1884.8	3769.6	9493	1898.6	3797.2
9286	1857.2	3714.4	9356	1871.2	3742.4	9425	1885	3770	9494	1898.8	3797.6
9287	1857.4	3714.8	9357	1871.4	3742.8	9426	1885.2	3770.4	9495	1899	3798
37	1857.5	3715	9358	1871.6	3743.2	9427	1885.4	3770.8	9496	1899.2	3798.4
9288	1857.6	3715.2	9359	1871.8	3743.6	9428	1885.6	3771.2	9497	1899.4	3798.8
9289	1857.8	3715.6	9360	1872	3744	9429	1885.8	3771.6	9498	1899.6	3799.2
9290	1858	3716	9361	1872.2	3744.4	9430	1886	3772	9499	1899.8	3799.6
9291	1858.2	3716.4	9362	1872.4	3744.8	9431	1886.2	3772.4	9500	1900	3800
9292	1858.4	3716.8	112	1872.5	3745	9432	1886.4	3772.8	9501	1900.2	3800.4
9293	1858.6	3717.2	9363	1872.6	3745.2	9433	1886.6	3773.2	9502	1900.4	3800.8
9294	1858.8	3717.6	9364	1872.8	3745.6	9434	1886.8	3773.6	9503	1900.6	3801.2
9295	1859	3718	9365	1873	3746	9435	1887	3774	9504	1900.8	3801.6
9296	1859.2	3718.4	9366	1873.2	3746.4	9436	1887.2	3774.4	9505	1901	3802
9297	1859.4	3718.8	9367	1873.4	3746.8	9437	1887.4	3774.8	9506	1901.2	3802.4
9298	1859.6	3719.2	9368	1873.6	3747.2	187	1887.5	3775	9507	1901.4	3802.8
9299	1859.8	3719.6	9369	1873.8	3747.6	9438	1887.6	3775.2	9508	1901.6	3803.2
9300	1860	3720	9370	1874	3748	9439	1887.8	3775.6	9509	1901.8	3803.6
9301	1860.2	3720.4	9371	1874.2	3748.4	9440	1888	3776	9510	1902	3804
9302	1860.4	3720.8	9372	1874.4	3748.8	9441	1888.2	3776.4	9511	1902.2	3804.4
9303	1860.6	3721.2	9373	1874.6	3749.2	9442	1888.4	3776.8	9512	1902.4	3804.8
9304	1860.8	3721.6	9374	1874.8	3749.6	9443	1888.6	3777.2	262	1902.5	3805
9305	1861	3722	9375	1875	3750	9444	1888.8	3777.6	9513	1902.6	3805.2
9306	1861.2	3722.4	9376	1875.2	3750.4	9445	1889	3778	9514	1902.8	3805.6
9307	1861.4	3722.8	9377	1875.4	3750.8	9446	1889.2	3778.4	9515	1903	3806
9308	1861.6	3723.2	9378	1875.6	3751.2	9447	1889.4	3778.8	9516	1903.2	3806.4
9309	1861.8	3723.6	9379	1875.8	3751.6	9448	1889.6	3779.2	9517	1903.4	3806.8
9310	1862	3724	9380	1876	3752	9449	1889.8	3779.6	9518	1903.6	3807.2
9311	1862.2	3724.4	9381	1876.2	3752.4	9450	1890	3780	9519	1903.8	3807.6
9312	1862.4	3724.8	9382	1876.4	3752.8	9451	1890.2	3780.4	9520	1904	3808
62	1862.5	3725	9383	1876.6	3753.2	9452	1890.4	3780.8	9521	1904.2	3808.4
9313	1862.6	3725.2	9384	1876.8	3753.6	9453	1890.6	3781.2	9522	1904.4	3808.8
9314	1862.8	3725.6	9385	1877	3754	9454	1890.8	3781.6	9523	1904.6	3809.2
9315	1863	3726	9386	1877.2	3754.4	9455	1891	3782	9524	1904.8	3809.6
9316	1863.2	3726.4	9387	1877.4	3754.8	9456	1891.2	3782.4	9525	1905	3810
9317	1863.4	3726.8	137	1877.5	3755	9457	1891.4	3782.8	9526	1905.2	3810.4
9318	1863.6	3727.2	9388	1877.6	3755.2	9458	1891.6	3783.2	9527	1905.4	3810.8
9319	1863.8	3727.6	9389	1877.8	3755.6	9459	1891.8	3783.6	9528	1905.6	3811.2
9320	1864	3728	9390	1878	3756	9460	1892	3784	9529	1905.8	3811.6
9321	1864.2	3728.4	9391	1878.2	3756.4	9461	1892.2	3784.4	9530	1906	3812
9322	1864.4	3728.8	9392	1878.4	3756.8	9462	1892.4	3784.8	9531	1906.2	3812.4
9323	1864.6	3729.2	9393	1878.6	3757.2	212	1892.5	3785	9532	1906.4	3812.8
9324	1864.8	3729.6	9394	1878.8	3757.6	9463	1892.6	3785.2	9533	1906.6	3813.2
9325	1865	3730	9395	1879	3758	9464	1892.8	3785.6	9534	1906.8	3813.6
9326	1865.2	3730.4	9396	1879.2	3758.4	9465	1893	3786	9535	1907	3814
9327	1865.4	3730.8	9397	1879.4	3758.8	9466	1893.2	3786.4	9536	1907.2	3814.4
9328	1865.6	3731.2	9398	1879.6	3759.2	9467	1893.4	3786.8	9537	1907.4	3814.8
9329	1865.8	3731.6	9399	1879.8	3759.6	9468	1893.6	3787.2	287	1907.5	3815
9330	1866	3732	9400	1880	3760	9469	1893.8	3787.6	9538	1907.6	3815.2
9331	1866.2	3732.4									

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Glossary

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A/D-converter	Analog-to-digital converter
ACI	Accessory Control Interface
ADC	Analog-to-digital converter
ADSP	Application DPS (expected to run high level tasks)
AGC	Automatic gain control (maintains volume)
ALS	Ambient light sensor
AMSL	After Market Service Leader
ARM	Advanced RISC Machines
ARPU	Average revenue per user (per month or per year)
ASIC	Application Specific Integrated Circuit
ASIP	Application Specific Interface Protector
B2B	Board to board, connector between PWB and UI board
BB	Baseband
BC02	Bluetooth module made by CSR
BIQUAD	Bi-quadratic ,type of filter function)
BSI	Battery Size Indicator
BT	Bluetooth
CBus	MCU controlled serial bus connected to UPP_WD2,UEME and Zocus
CCP	Compact Camera Port
CDSP	Cellular DSP (expected to run at low levels)
CLDC	Connected limited device configuration
CMOS	Complimentary metal-oxide semiconductor circuit (low power consumption)
COF	Chip on Foil
COG	Chip on Glass
CPU	Central Processing Unit
CSR	cambridge silicon radio
CSTN	Color Super Twisted Nematic
CTSI	Clock Timing Sleep and interrupt block of Tiku
CW	Continuous wave
D/A-converter	Digital-to-analouge converter
DAC	Digital-to-analouge converter
DBI	Digital Battery Interface
DBus	DSP controlled serial bus connected between UPP_WD2 and Helgo
DCT-4	Digital Core Technology
DMA	Direct memory access
DP	Data Package

DPLL	Digital Phase Locked Loop
DSP	Digital Signal Processor
DtoS	Differential to Single ended
EDGE	Enhanced data rates for global/GSM evaluation
EGSM	Extended GSM
EM	Energy management
EMC	Electromagnetic compability
EMI	Electromagnetic interference
ESD	Electrostatic discharge
FCI	Functional cover interface
FPS	Flash Programming Tool
FR	Full rate
FSTN	Film compensated super twisted nematic
GND	Ground, conductive mass
GPIB	General-purpose interface bus
GPRS	General Packet Radio Service
GSM	Group Special Mobile/Global System for Mobile communication
HF	Hands free
HFCM	Handsfree Common
HS	Handset
HSCSD	High speed circuit switched data (data transmission connection faster than GSM)
HW	Hardware
I/O	Input/Output
IBAT	Battery current
IC	Integrated circuit
ICHAR	Charger current
IF	Interface
IHF	Integrated hands free
IMEI	International Mobile Equipment Identity
IR	Infrared
IrDA	Infrared Data Associasion
ISA	Intelligent software architecture
JPEG/JPG	Joint Photographic Experts Group
LCD	Liquid Crystal Display
LDO	Low Drop Out
LED	Light-emitting diode

LPRF	Low Power Radio Frequency
MCU	Micro Controller Unit (microprocessor)
MCU	Multiport control unit
MIC, mic	Microphone
MIDP	Mobile Information Device Profile
MIN	Mobile identification number
MIPS	Million instructions per second
MMC	Multimedia card
MMS	Multimedia messaging service
NTC	Negative temperature coefficient, temperature sensitive resistor used as a temperature sensor
OMA	Object management architechture
OMAP	Operations, maintenance, and administartion part
Opamp	Operational Amplifier
PA	Power amplifier
PDA	Pocket Data Application
PDA	Personal digital assistant
PDRAM	Program/Data RAM (on chip in Tiku)
Phoenix	Software tool of DCT4.x
PIM	Personal Information Management
PLL	Phase locked loop
PM	(Phone) Permanent memory
PUP	General Purpose IO (PIO), USARTS and Pulse Width Modulators
PURX	Power-up reset
PWB	Printed Wiring Board
PWM	Pulse width modulation
RC-filter	Resistance-Capacitance filter
RF	Radio Frequency
RF PopPort TM	Reduced function PopPortTM interface
RFBUS	Serial control Bus For RF
RSK	Right Soft Key
RS-MMC	Reduced size Multi Media Card
RSSI	Receiving signal strength indicator
RST	Reset Switch
RTC	Real Time Clock (provides date and time)
RX	Radio Receiver

SARAM	Single Access RAM
SAW filter	Surface Acoustic Wave filter
SDRAM	Synchronous Dynamic Random Access Memory
SID	Security ID
SIM	Subscriber Identity Module
SMPS	Switched Mode Power Supply
SNR	Signal-to-noice ratio
SPR	Standard Product requirements
SRAM	Static random access memory
STI	Serial Trace Interface
SW	Software
SWIM	Subscriber/Wallet Identification Module
TCXO	Temperature controlled Oscillator
Tiku	Finnish for Chip, Successor of the UPP
TX	Radio Transmitter
UART	Universal asynchronous receiver/transmitter
UEME	Universal Energy Management chip (Enhanced version)
UEMEK	See UEME
UI	User Interface
UPP	Universal Phone Processor
UPP_WD2	Communicator version of DCT4 system ASIC
USB	Universal Serial Bus
VBAT	Battery voltage
VCHAR	Charger voltage
VCO	Voltage controlled oscillator
VCTCXO	Voltage Controlled Temperature Compensated Crystal Oscillator
VCXO	Voltage Controlled Crystal Oscillator
Vp-p	Peak-to-peak voltage
VSIM	SIM voltage
WAP	Wireless application protocol
WD	Watchdog
XHTML	Extensible hypertext markup language
Zocus	Current sensor, (used to monitor the current flow to and from the battery)